Standard Size, 9 x 12. FEBRUARY 6, 1902. Price Eight Cents.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS,

Vol. 25. 218 WILLIAM STREET, NEW YORK. No. 6

Index to Advertisers and Classified Index Following Reading Matter.

Correctly Cut Gears

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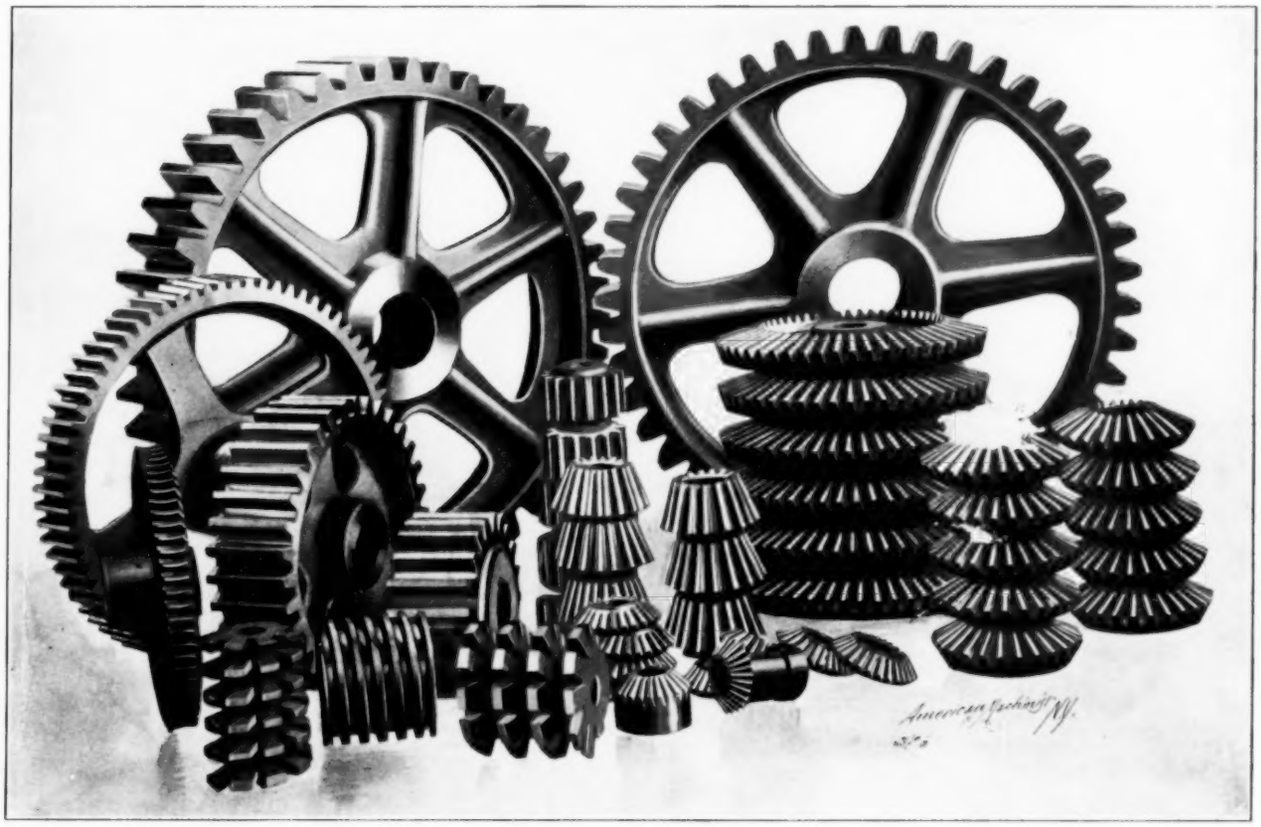

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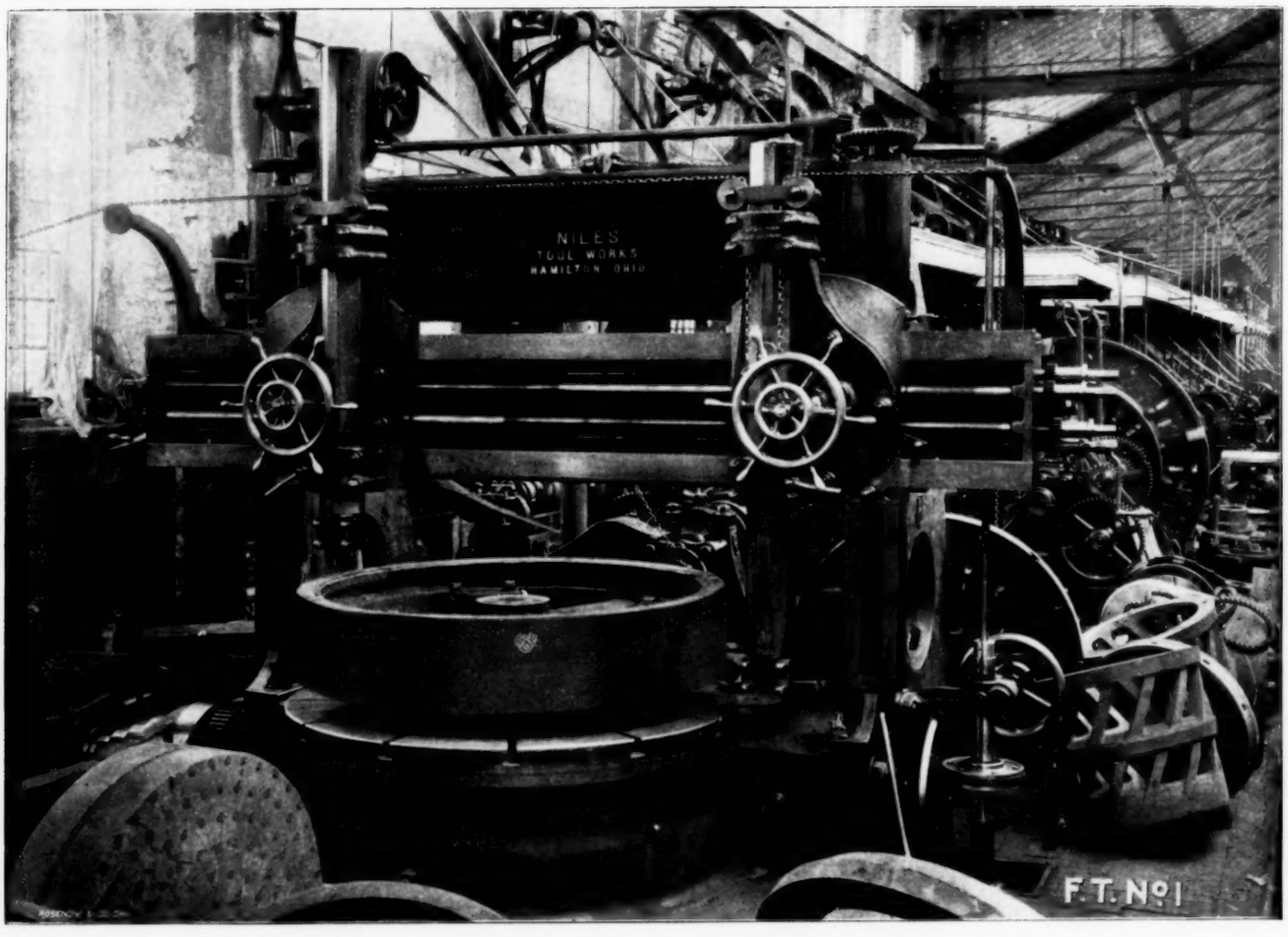

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Cutting Cams in the Lathe.

The accompanying sketches illustrate a makeshift fixture used for cutting a hundred cams, a job that recently came to the writer.

Fig. 1 represents the developed face of the cam and shows the shape of the groove in the cam face. The fixture was used in an 18-inch engine lathe which had been rigged up for cylindrical grinding with a drum overhead.

The cam castings were first bored to gage and the hubs faced on a vertical chucking mill, the blank being then turned to size on a face-plate arbor.

Referring to Fig. 2, *A* is a cast-iron block tongued and bolted to the regular lathe tool head with a dovetailed block *B* gibbed to its upper surface. Holes drilled at *C* and *E* carry respectively the stud or pin *F* and the roughing tool *G* held in place by the nut as shown. The pin *F* carries on its outer end a hardened roll, and is backed by the helical spring *D*.

Having a sample cam furnished, this was mounted on the face-plate arbor near the lathe head. Next on the arbor was the cam blank, both being held securely in place by the nut on the end of the arbor and driven by a stud projecting from the face-plate between the arms of the master cam. It will be evident that with the lathe carriage locked in position, the roll on the end of pin *F* running in the groove of the sample cam, block *B* will partake of the cam motion, and reproduce the groove in the cam blank, the tool block being fed into its cut by the regular cross feed, and the spring *D* keeping the pin roll always at the bottom of the sample cam groove, whether the cutting tool is at the bottom of its cut or withdrawn for the removal of the roughed-out cam.

This roughing tool was made slightly under size to allow for the finishing cut, which was made with the same fixture, substituting for the roughing tool a small spindle carrying an end mill and driven by a belt from the overhead drum.

The slowest lathe speed being much too fast for the feed, a small worm was cut to mesh into the large gear on the lathe spindle. This was supported on a shaft running in hardwood boxes bolted to lathe bearing as shown in Figs. 3 and 4. A pulley, made of ⅞-inch board with a V-groove in its periphery, was mounted on this shaft and driven by a round belt, also from the drum shaft, which extended through the hanger far enough to carry the sleeve *H*, Fig. 3, which does the driving. The whole arrangement is shown in Figs. 3 and 4. J. C. B.

As we understand the purport of a press despatch before us, a union of coal teamsters in Chicago has served notice that it will deliver no coal to business buildings unless coal will be used in them at all times to the exclusion of fuel gas, which it seems they object to the use of.

Echoes from the Oil Country.

GIVING AND FOLLOWING ORDERS—CATCHING THREADS IN SCREW CUTTING.

If there is one point more than another which should be given particular attention by a foreman in a jobbing shop it is in the matter of giving orders. The machinist's language is so varied, and there are so many dialects in it, that one does not always convey the same meaning to different men with the same words. Most machinists have a pretty good understanding of these things, and it is the exception that sends the "cold" chills chasing up and down the spinal column and makes

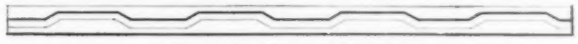
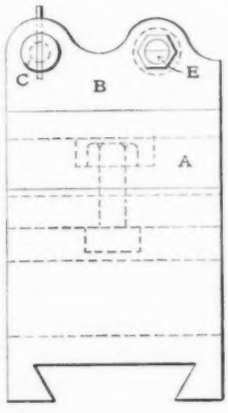
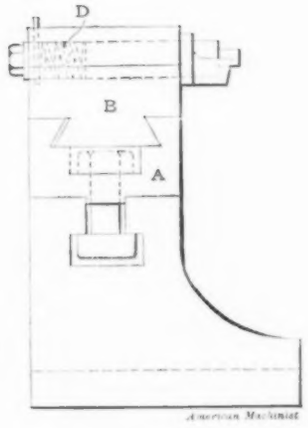


Fig. 1 Development of the Cam





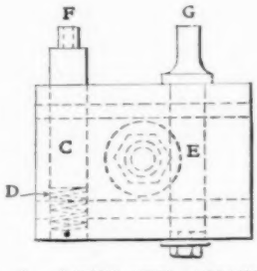


FIG. 2. LATHE TOOL ARRANGED FOR CAM CUTTING.

the hair turn gray, while occasionally the case is so pronounced that one feels the entire inadequacy of his supply of language to do justice to his feelings in regard to the lack of knowledge of his trade language displayed by the other fellow.

If there is a foreman that has not had this experience to some extent, either he is a born genius in his use of language and powers of gaging the capacity of the workman, or else he has never had the pleasure of bossing a general jobbing shop in busy times when men were coming and going frequently. I can imagine the feelings of the foreman who gave a new man a piston ring to cut *in two* and found that he had literally cut it in two, instead of apart; or the one who gave a man some shafts to turn that were to have some wheels shrunk on with an allowance of 1-100 inch for shrink, and then had them turned 1-100 smaller than the holes so as to give a chance to *shrink* them to a nice running fit.

Of course a knowledge of the previous experience of these men might have headed off these blunders, but unfortunately for his peace of mind, a foreman can't know everything, although he may often think he needs to and wish he did.

In one case that jarred me somewhat I could hardly blame it on the lack of plain orders, although it was a case of a man following them too closely. I had been away for a few days, and a new man, who had worked and learned his trade in a similar shop, had been put on in my absence. He was supposed to be a very good man, having been at it for years and gotten the highest price the shop paid where he had worked. Before we got through with him we found that he was a specialist who knew one thing well, but who did not care to risk over-taxing his mind either by studying or seeing what his fellow workman was doing and thinking about it.

The first job he was given required turning off, drilling a hole through it (a 2¼-inch hole, 22 inches long), boring out one end to a sharp taper and cutting an internal thread. He was at work on the thread when I put in an appearance. The man in charge hailed my approach with joy and made haste to turn things into my hands, telling me he had been having an awful time with Tom and that he guessed his job was spoiled, or would be before I could get down to that end of the shop. Of course I lost no time in getting there, and found a hole that was everything but round and straight, and a thread—well, I can't describe it. I have seen a good many first attempts by cubs, but cannot

draw out from my memory anything that deserves to rank with that. It had a certain peculiar distinctiveness that was all its own, that took it out of the ranks of ordinary bad work and put it in a class by itself.

Tom showed plainly he was stuck as I came up with "Well, Tom, what seems to be the matter?" "I don't know, Mr. Osborne, but I don't seem to be able to get things to work right. You see, I never cut a thread before. I can turn more crank pins than any man you ever had in your shop. I have worked seventeen years at the business and I got tired turning cranks, and so quit at Blanks. Up there they had machines for cutting threads and the boys had to do those they cut on the lathe. The crank job was the best lathe job and the highest pay in the shop, and I never paid any attention to the kids." He spoke with the sweat streaming off his face, while I had been trying to make out how he had cut such a looking thread. His thread tool seemed in fairly good shape. (One of the other men had ground and set it for him, I found out afterward.)

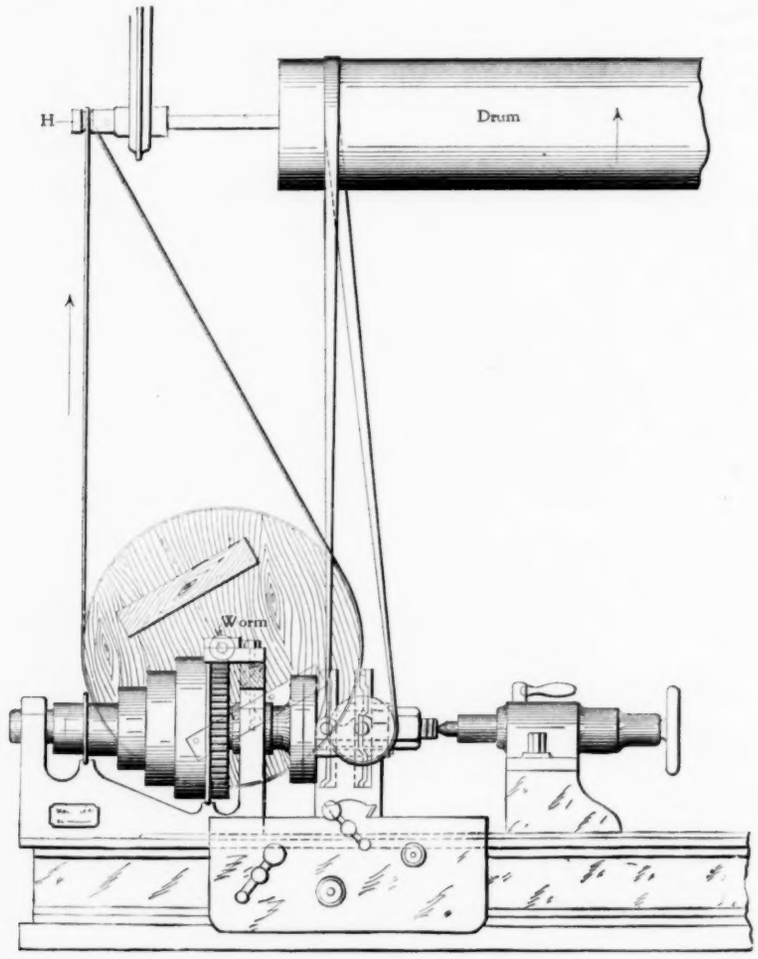


Fig. 3

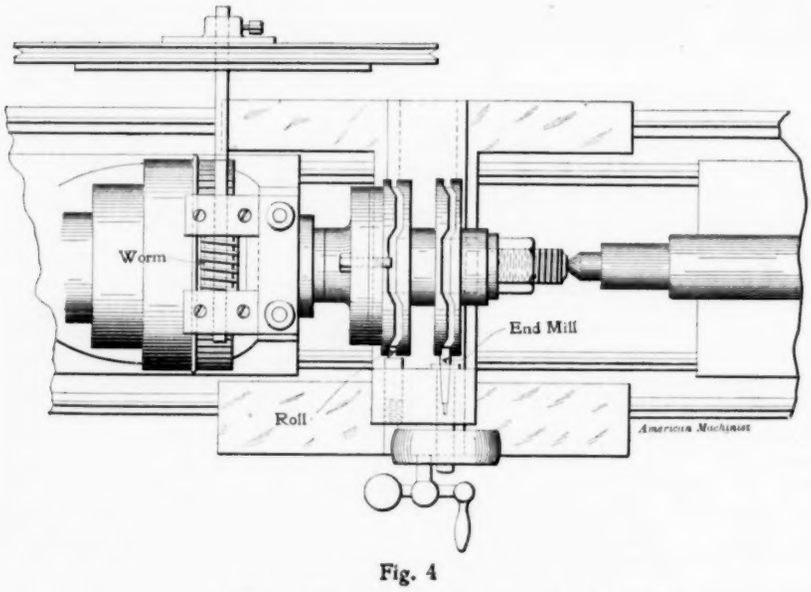


Fig. 4

PLAN AND ELEVATION OF CAM CUTTING RIG.

"That is rather a tough specimen of a thread," I remarked. "How did you get it looking like that?"

"Why, I had it looking pretty good—at least a good bit better than that—when Joe (who had been in charge) came up and told me to run back and scrape it and he guessed we could let it go. I didn't know they ever had to do that way, but of course I did as he told me, and it made it worse. I thought maybe I hadn't scraped hard enough, and I tried it again, and just then you came up, and here it is." And he looked like the personification of misery and disgust.

Further inquiry showed he had run the lathe backward ("run back") and let the tool scrape hard as it came out. By careful nursing I brought that thread back to something like health, and Tom decided that the existence of a job hand was a little too strenuous for him and quit, declaring that his orders had been to run back and scrape that thread, and that, while he thought it rather strange, the order should not have been given by one in authority unless intended to be obeyed.

And speaking of threads, one foreman near by was mystified. He chanced to walk by one of his men who had been given some threads to cut 11½ to the inch and found him throwing out and in without stopping or reversing.

Horrors! A lot of taps gone to junk. To stop the lathe and start reading the riot act to the man was the work of a very few seconds. The man very innocently asked what was eating him to make him take a fit like that.

"Why in the dickens didn't you cut those threads as I told you? They are 11½ to the inch. I told you that plain enough, and, besides. you cut a lot before this," he retorted, warmly. If you've ever been there you know just how he felt. "I'm cutting these 11½," replied the man. "Not much you're not; that lead screw won't throw in for 11½, or any other screw I ever saw," said the foreman. "They all do for me, for any thread I want to cut," replied the man.

The foreman measured the thread to show his sense of justice before firing the man, and was somewhat surprised to find it 11½, and as the thread was sharp and clean cut in every way he could find no fault and walked away, while the man started up and was soon throwing in and

out without stopping or backing the lathe, as though it was impossible to miss.

Some of the men near by had heard the conversation, or altercation, rather, and began figuring out how it was done, and they finally asked the man, who only laughed and said: "You fellows don't know how to gear up your lathes right; you better turn to and learn the trade." The result was a lot of figuring on how to gear a lathe so as to cut any thread the same as those that divided evenly by the lead screw.

The wrinkle is a very simple one, although one must know where to gear before trying it. The place to do the gearing is in the man, and he must do it himself.

The trick is done in this way. Of course every lathe man knows (nearly every one, that is) that he can throw in on most threads at each inch, and on 4½ and 11½ (which are the fractional threads met with very often in regular work) at every two inches. Some lathes have a star or pointer to tell when the even inches come, but these are not of much benefit to the *geared* man, who will proceed about in this way. Begin as in ordinary practice and throw out the nut at the end of the thread without stopping the lathe and run back the carriage to where you would if you reversed the lathe. Close the nut and let the tool run up without being set into the cut and see if it matches with the cut that was taken the first time. If not, stop the lathe, open the nut and go back one thread of the nut; if that does not match go back another one and so on until it does, noting how far back you went; then start up and run the cut up as before, but when running the carriage back to throw in go as much farther before throwing in as you had to open up and go back on the lead screw. A few trials will convince you that it is very easy to gage your movements so you hit right every time. A little practice and the trick is learned—not half as hard as learning to ride a bicycle, and, like that, the only way to learn it is to take hold and do it.

A lathe with a coarse lead screw is easiest to learn on, but it is just as easy by this way to cut a fine thread as a coarse thread, and a slow speed of the lathe is easier than a rapid one. Some men use the footstock as a gage to run the carriage back against, setting it after they find how far from the end of the piece they need to go to come right, but this is generally looked on as unnecessary by the veterans in our shop.

We find that this practice makes a difference of about 50 per cent. in cutting ordinary threads, say up to 3 or 4 inches long, as most of ours are; and if a new man has been in the habit of using calipers with sharp points for measuring his finished sizes we persuade him to leave them in his tool box and use a pair with blunt or rounded points that will go only partly down, and surprise him a little and save a few more per cent., besides getting much better work.

The lathes we use most in this work have lead screws with ¼ inch pitch, which give quite a range, although one lathe is ⅓ inch pitch and is used in the same way. I have never tried this trick on brass or very small work that ran rapidly, as the range one has is a little less than one-half the time to go the pitch of the screw being cut. With a square thread lead screw I always aim to get back a trifle too soon and have the nut shut down enough to drop in as soon as the proper place is reached.

For fear my explanation may not be as plain as it should be, I will give an illustration: Supposing I had 1-inch threads, 2¼ inches long, to cut and the lead screw was 4 to the inch. If I threw out, ran back and threw in ¼ inch from the end of the thread (that is running back 2½ inches) while the lead screw made two turns, I would be in the right place, just the same as if I had stopped the lathe and ran back 3 inches by a scale. If I find I get back before the lead screw makes two turns I must either move slower or go back farther, or, if we are very near together, wait for it to get there. If I do not get there quick enough and the thread being cut will divide by 2, I would go back and try to get the next ½ inch. If the thread would not divide by 2 I would have to take the next inch. With myself, I find the easiest way is to move at my regular speed and throw in at the place that suits that.

I suppose most lathemen who cut many threads use the compound rest set at an angle a little less than 30 degrees and set their cut with that, using the lower handle to withdraw the tool and return it always to the same place. This takes off some of the strain of remembering just where the handle stood, makes the tool cut all on one side, except a light scrape, and, should the lead screw nut have any slack, keeps it all one way, unless the compound rest chances to be turned the wrong way. We swing the handle toward the tailstock for outside threads. W. OSBORNE.

New English Types of Gages — Standards for Different Kind of Fits.

The Newall Engineering Company, of 36 Featherstone street, London, E. C., send us particulars of some new types of gages which they have developed and a table of standard allowances for different kinds of fits which is the result of extended inquiry. This matter of fits is of large importance, and we hope their request for suggestions and criticisms will bear fruit. In explaining the need of these new gages they say:

We would like to draw attention to an apparent absurdity in the present system of gages for shop use. They are generally either plugs and rings, or caliper (snap) and flat bar gages. When sizing holes and the pieces that are to fit in them, the usual custom is to make the hole standard within a small margin for error and then vary the diameter of the piece that goes inside according as a press fit, a driving fit or a running fit is wanted. To test the correctness of the hole, the usual plug or bar gage is all right, especially if made double-ended and sized to the difference allowed for error. But the ring or caliper gage is absolutely useless. If a force fit is required, the ring will not pass over the rod, while if a running fit is required, the ring will be so loose that it is no gage at all. A complete set of ring gages for all the variations required would be costly, especially when it is remembered that gages wear out rather quickly when in general shop use for fitting.

It appeared to us that an adjustable caliper gage with two pairs of measuring points which could be adjusted separately to cheaply made male difference gages, would be a convenient solution of the difficulty. Accordingly, we made some for use in our own works, and, having found them most convenient, we have engaged in their manufacture. To carry out the idea, as well as to take advantage of the standard allowances for press, driving and running fits given below, we have prepared three series of gages:

Firstly, we have a series of internal limit gages of the usual type, shown in Fig. 1, the two ends of which represent the maximum and minimum error allowed on each size hole.

Secondly, we have a series of hardened steel bar gages, shown in Fig. 2, which are ground to the maximum and minimum diameters allowed for each kind of fit.

Thirdly, we have a series of adjustable caliper gages, shown in Fig. 3, each with two pairs of measuring points. The smaller sizes have a range of ¼ inch and the larger ones of ½ inch.

The gages shown in Fig. 2 are only intended to be used for setting the calipers shown in Fig. 3. The wear on them will therefore be practically *nil*, while, as the calipers will be freshly adjusted each time they are used, the equivalent of a new caliper, accurately adjusted, will be used for each job. Should the points get worn unequally they can be reground, or should they be permanently damaged they can be renewed in either case at a very small cost. Thus it will be seen that we offer, at a small initial cost what is, for practical working purposes, an infinite series of solid caliper difference gages, which will never wear out of truth.

We use letters to distinguish the various fits, and the bar gages are marked in the same way. If those letters are used to mark the drawings, the workman will at once know what gage and setting to ask for.

We have collected the practice of the leading English, Continental and American engineering firms on this point and herewith present a provisional table which is the average of all the data received, and

Fig. 1 Limit Gage for Gaging Holes

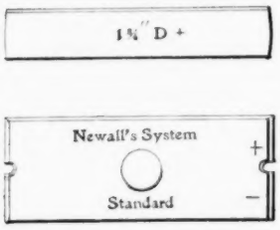


FIG. 2. GAGE FOR SETTING CALIPER GAGE SHOWN IN FIG. 3.

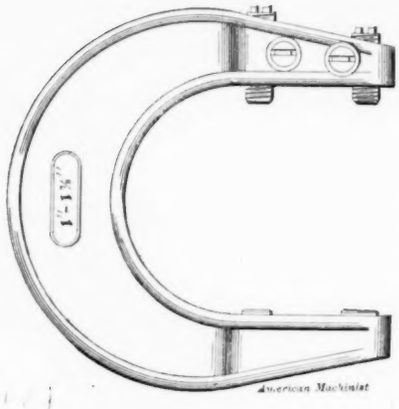


FIG. 3. ADJUSTABLE LIMIT CALIPER GAGE.

we venture to hope that it may be useful to and accepted by the trade as a standard. It is, however, offered for criticism, as we are anxious to have it perfect. We may add that every point in it is covered by the practice of some good firm.

Hardening Rings.

BY E. R. MARKHAM.

We had twenty large tool-steel rings to harden for an outside party. They were 16 inches in diameter, 4 inches wide and 2¼ inches thick. They had allowed thirty thousandths of an inch inside and out for grinding.

It was necessary that they should be extremely hard on the inner surface, as they would be subjected to the action of two swaging hammers striking 3,000 blows per minute each. The slightest crack on the surface mentioned would have made them unfit for use.

Upon inquiry I found that the rings had not been annealed after roughing out; in fact, had not been annealed at all since forging. The blacksmith had considered them hot enough after the finish forging to anneal properly. I was somewhat skeptical as to the results, so far as springing was concerned, as I am always careful to anneal any large or irregular shaped piece after roughing somewhere near to shape, to remove any tendency to crack or spring which might be occasioned by strains in the steel caused by the rolling or hammering in the steel mill or the forge shop.

I decided to heat the rings in large round iron boxes about 18 or 20 inches inside diameter and about 10 inches deep. We first put in a layer of powdered charcoal about 2 inches deep, laid the ring on this, filled in with a mixture of 4 parts powdered charcoal and 1 part charred leather, so as to cover the ring to a depth of a half an inch; put a loose cover on the box and placed it in the oven.

In about four hours the ring was red hot. It was allowed to run about an hour at a low heat, to insure its heating uniformly throughout, as an uneven heat, even if not high, is much more dangerous than an even heat which is a trifle higher than is necessary. At the expiration of the time mentioned the heat was gradually increased until the piece was a good full red. It is necessary to heat a large piece of steel hotter than you would a small piece made from the same bar. When the ring had reached the required heat, and was heated uniformly, the box was removed from the furnace. With two pairs of long tongs, two men grappled on to the ring on opposite sides, drew it from the box and laid on a holder (see sketch) which consisted of an iron ring made of 1 inch square iron bent and welded, having three rods which served as handles. Two of these, *A* and *B*, were fixed securely to the ring while the third was detachable, so as to be removed when placing the heated work in position for dipping. The third handle was then screwed in place. Three men, with their hands and arms well covered to protect them from the steam which would rise when such a mass of heated metal was plunged in the water, took the fixture and immersed the work in the tank, while a fourth man threw a pint of fine salt in just ahead of it. The tank had an inlet pipe at the bottom which was opened before immersing the piece. It was worked up and down very thoroughly until the red had entirely disappeared, when the inlet valve was nearly closed, allowing only enough water to enter to cool it somewhat slowly.

When it was cool it was taken from the water and placed over a fire and the strain removed by heating it until it would snap when touched with the moistened finger. It was then laid on a board where

Nominal Diameters . .	½″	1″	2″	3″	4″	5″	6″
Over size	.00025	.00050	.00075	.00100	.00100	.00100	.00150
Under size	.00025	.00025	.00025	.00050	.00050	.00050	.00050
Margin	.00050	.00075	.00100	.00150	.00150	.00150	.00200

LIMITS IN PLUG GAGES FOR STANDARD HOLES.

Nominal Diameters . .	½″	1″	2″	3″	4″	5″	6″
Mean	.00075	.00175	.00350	.00525	.00700	.00900	.01100
High	.00100	.00200	.00400	.00600	.00800	.01000	.01200
Low	.00050	.00150	.00300	.00450	.00600	.00800	.01000
Margin	.00050	.00050	.00100	.00150	.00200	.00200	.00200

ALLOWANCES—OVER STANDARD—FOR FORCE FITS.

Nominal Diameters . .	½″	1″	2″	3″	4″	5″	6″
Mean	.000375	.000875	.00125	.00200	.00250	.00300	.00350
High	.00050	.00100	.00150	.00250	.00300	.00350	.00400
Low	.00025	.00075	.00100	.00150	.00200	.00250	.00300
Margin	.00025	.00025	.00050	.00100	.00100	.00100	.00100

ALLOWANCES—OVER STANDARD—FOR DRIVING FITS.

Nominal Diameters . .	½″	1″	2″	3″	4″	5″	6″
High	.00025	.00050	.00100	.00150	.00150	.00200	.00200
Low	.00075	.00100	.00150	.00200	.00250	.00250	.00250
Margin	.00050	.00050	.00050	.00050	.00050	.00050	.00050

ALLOWANCES—BELOW STANDARD—FOR PUSH OR KEYING FITS, CLASS P GAGES.

Class of Gage,	Diameters,	½″	1″	2″	3″	4″	5″	6″
X.	Mean	.00150	.00200	.00260	.00320	.00380	.00440	.00500
	High	.00100	.00125	.00175	.00200	.00250	.00300	.00350
	Low	.00200	.00275	.00350	.00425	.00500	.00575	.00650
	Margin	.00100	.00150	.00175	.00225	.00250	.00275	.00300
Y.	Mean	.00100	.00150	.00190	.00230	.00270	.00310	.00350
	High	.00075	.00100	.00125	.00150	.00200	.00225	.00250
	Low	.00125	.00200	.00250	.00300	.00350	.00400	.00450
	Margin	.00050	.00100	.00125	.00150	.00150	.00175	.00200
Z.	Mean	.000625	.00100	.00120	.00140	.00160	.00180	.00200
	High	.00050	.00075	.00075	.00100	.00100	.00125	.00125
	Low	.00075	.00125	.00150	.00200	.00225	.00250	.00275
	Margin	.00025	.00050	.00075	.00100	.00125	.00125	.00150

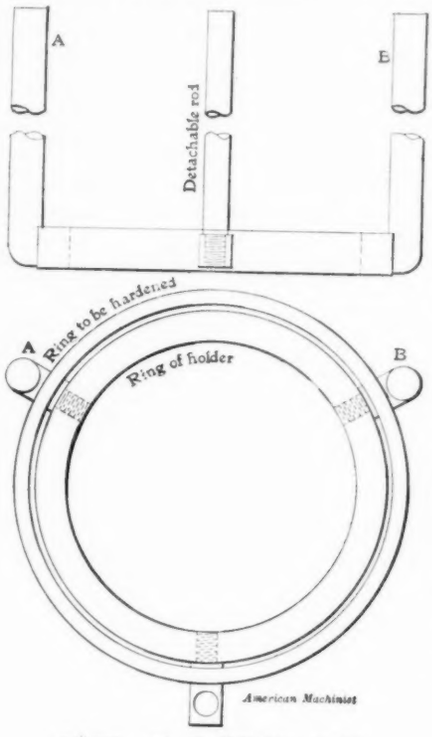
Class X is suitable for engine and other work where easy fits are wanted.
Class Y is suitable for high speeds and good average machine work.
Class Z is suitable for fine tool work.

CLEARANCES FOR RUNNING FITS.

LIMITS AND ALLOWANCES IN WORK SHOP GAGES FOR DIFFERENT KINDS OF FITS.

no current of air could strike it and left to cool.

The twenty rings were hardened without a crack. Every one stood the test given, which was with a file for hardness, and striking with hammer and prick punch for depth. They could be neither filed nor



HOLDER FOR HARDENING RINGS.

dented. The greatest amount any of them sprung was eight thousandths of an inch.

We thought, considering that they were made of high-grade tool steel and had not been annealed, that the results were very gratifying.

Some Ingenious Inventions.

BY HOWARD A. COOMBS.

Everyone who makes an invention does so, I take it, in one of the three following ways: Either the idea comes to him as a sudden inspiration suggested by some surrounding circumstances, without any effort on his part, or he discovers by diligent search the solution to a problem for which he had long sought, or he sits down with some well-defined plan in mind and designs a machine or apparatus that will accomplish the desired result.

The first way might be called invention by chance and the third way invention by design, while the second way partakes somewhat of the nature of both the others. That is to say, inasmuch as there is present in the inventor's mind a goal or result at which he aims, the second way resembles invention by design, and because the solution, if found at all, comes to him as a happy thought, or as a sudden insight, it is akin to invention by chance.

It is probably true that inventions of the last mentioned class occur but infrequently. Nevertheless, some of the most revolutionary inventions, or, as they are more properly called, discoveries, originated by chance. It is said that glass was discovered accidentally by some fishermen who covered with sand a fire they had built on the beach, and that Goodyear first vulcanized rubber by letting fall on a hot stove a piece of rubber covered with powdered sulphur. Some smaller, yet eminently successful inventions have also originated as unsought-for bright ideas in the minds of their inventors, such as the paper fastener, which is said to have occurred to a clerk in the Treasury Department at Washington as he rode home in the car, and the rubber eraser on the pencil, both of which are reported to have made fortunes for their inventors, although the patent for the latter was later adjudged to be invalid for lack of invention.

Of course the bright idea is not sufficient in itself. One must have good common sense and business ability in order to make a commercial success of it. It is like a miner who finds a nugget in a district where "might is right' and "possession is nine points of the law." He must have the skill and the watchfulness and the courage to protect himself from those who would rob him of his possession. But in both cases the first essential is to "strike it rich." That phrase reminds me of the story of the woman who returned from the Klondike with a satisfactory competency. When asked if she had had good success in mining, she replied that she had tried mining for a while, but that it was not until she opened a laundry that she struck pay dirt!

Invention by design is a prosaic but eminently practical method of making an invention. To some people it does not seem to be invention at all, for the reason that it is accomplished deliberately, in cold blood so to speak, and does not carry with it the idea of genius and inspiration. It has resulted, however, in producing most if not all of the automatic machines which have done so much to advance the position of the United States among manufacturing nations. To design such a machine requires a genius of a very high order, but it is rather that sort which is defined as "the capacity for taking infinite pains" than that which is subject to sudden inspirations.

But it is the second mentioned class of invention which involves, to my mind, the ideal operation of the inventive faculty. Here is a man who is confronted with a problem which must be solved if he would attain the result at which he aims, and he thinks about it and studies it and experiments, until one fine day the solution flashes upon him, or he finds that his experiments surely point out the road to success. Innumerable inventions are comprised in this class, examples of which readily suggest themselves—the phonograph and the incandescent lamp, for example.

This class includes also many smaller and humbler products of inventive faculty, such as the three or four examples described below. These are simple inventions, but each is, in my opinion, the result of considerable ingenuity in solving a problem or meeting requirements which, when stated, seem difficult, if not impossible to satisfy. I will first state the requirements in each case, so than anyone who is of an ingenious turn of mind and who likes to exercise his ingenuity, may try whether he can find a solution before "looking at the answer," as we used to say at school. I assume, of course, that these devices are unknown to many of the readers of the "American Machinist."

The first problem is, to so construct a wood-screw, without complicating its manufacture, that it can be driven in with an ordinary screwdriver but cannot be withdrawn by the same means.

The second is, to so support and drive an ordinary milling cutter that it can cut slots in a plate and leave the ends straight. This necessitates the passing through the plate of more than one-half the cutter. The word "ordinary" eliminates the use of an end mill.

The requirements of the third problem are as follows: To devise a method of making washers from a solid bar of stock, so that there will be no waste of material. All the metal of the bar is to be converted into washers, except perhaps a very short piece at the end.

The fourth problem is, to so support a tap in a nut-tapping machine that nut blanks can be fed to it, threaded and pass off it in a continuous unbroken stream.

Now if anyone, not previously acquainted with these inventions, has succeeded in re-inventing them by his own unaided ingenuity, then I would advise him to take to inventing as a business, for he surely has the inventive bump well developed.

The following descriptions and sketches, taken from the specified patents, give the solutions. The wood-screw which satisfies the requirements stated is shown in Fig. 1, and is taken from an 1872 patent to F. W. Brooks, of New York. The invention has therefore been public property for the last eleven years. The construction will be obvious from the sketch. A screwdriver when turned to the right takes against the abutments in the usual way, but when turned the other way rides up the inclined surfaces in exactly the way the teeth of one member of a snap-clutch ride up the teeth of the other member. This kind of screw is said to be useful in fastening down coffin lids so as guard against the depredations of ghouls, but is believed not to be guaranteed to keep out worms. A packing case held together by such screws would be secure against being unlawfully opened *en route*, and would have to be broken up on arrival at its destination, or if the customs officers desired to see its contents.

Fig. 2 shows how to mount a rotary cutter so that it can pass through a plate and

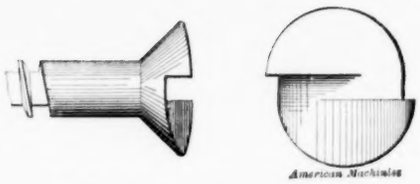


FIG. 1. A NON-REVERSIBLE SCREW.

from the holder, which fit into recesses in its sides. It is driven by a gear the teeth of which intermesh with the cutter teeth, of course contacting therewith only on the rear side, the teeth of the cutter being shaped somewhat like the detail sketch. To hold the cutter firmly a screw may be passed through its central aperture and

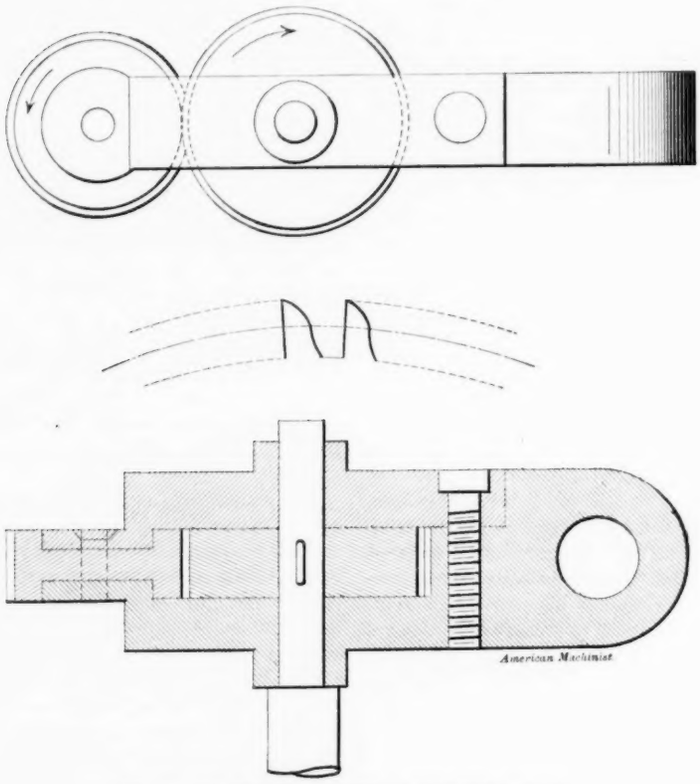


FIG. 2. FOR SLOTTING WITH A MILLING CUTTER.

this country in 1897 by F. W. Walker, of Leeds, England. First the bar is clamped between two dies and upset to fill an annular recess therein. This is done in two operations as shown, in order that the metal may the more certainly fill the recess. Then the plunger is brought up and forces the bar back, shearing off the flange previously formed, which thus becomes a washer. The same process can be repeated until the bar is too short to be clamped and upset, and thus practically the whole bar is used up in the washers, without the loss of any metal, even in chips.

The fourth problem states a seemingly impossible requirement. The nuts are to pass over the tap in unbroken continuity; there must be relative rotation between the nuts and the tap, and the latter must be held against endwise movement. The solution, shown in Fig. 4, is very simple. The unthreaded shank of the tap is curved around until its end is at right angles to the threaded part. The tap is entirely supported by the nuts which pass through two guide sleeves conforming in shape to the outline of the nuts, the first one of which is rotated by gearing, so that the nut blanks are threaded and fed along. The tap, of course, is prevented from rotating with them by its bent shank.

This very ingenious solution of the difficulty is due to A. H. Riggs, of Ocean Grove, N. J., and was patented by him in 1900. Other nut-tapping machines necessitate the removal of the nuts by hand whenever the shank of the tap gets "full," or the use of two pairs of gripping fingers or clamps which alternately grasp and release the tap to allow the nuts to pass

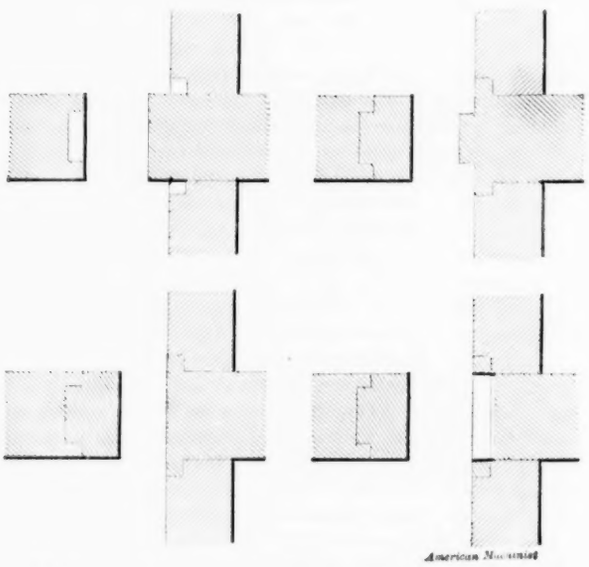


FIG. 3. WASHERS MADE WITHOUT WASTE OF MATERIAL.

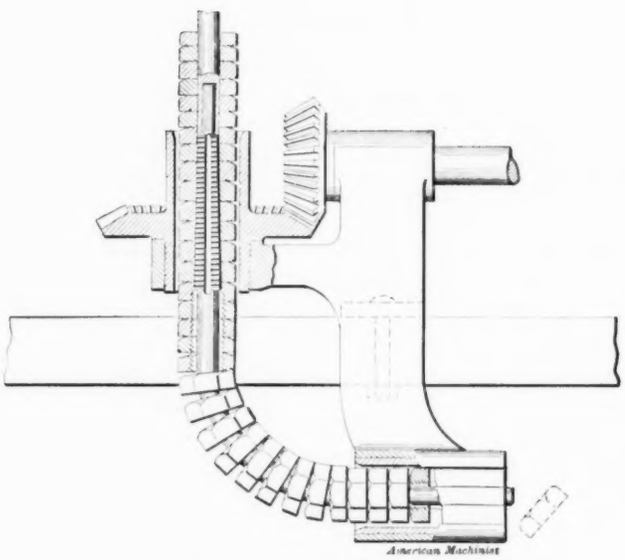


FIG. 4. A CONTINUOUS-WORKING TAP.

leave the ends of the slot square and straight. It was the invention of E. Salomon, of Montreal, and the patent on it expired about two years ago. The cutter is not mounted on a shaft at all, but is revolubly supported by two projections the two projections, as indicated in dotted lines.

Now we come to the method of making washers without any waste. Fig. 3 shows in four diagrammatic views the steps employed. This invention was patented in them, the former kind involving considerable loss of time, and the latter requiring a rather complicated and awkward mechanism, besides making it impossible to tap the nuts in uninterrupted succession.

A Piercing and Blanking Die, and a Novel Bending and Forming Die.

BY WILLIAM DORAN.

The piece, Fig. 1, is made of 1-16 inch hard sheet brass, and is used, after being formed and bent to the shape shown in Fig. 2, as a buckle clasp for leather straps. The blank has two holes *C C* and a long, square-ended slot at *B*. The two holes *C C* were required to be of different sizes in different lots of blanks, and for this reason the piercing and blanking die for producing them was made so as to allow this. The punch and die are shown in Fig. 3. The die *Q* is laid out in the regular way from the templet, and the blanking die is worked out at *R* to lines, and so that the templet will fit at the top, giving it only slight clearance to allow of frequent grinding without changing the shape and size of the blanks to any extent. The oblong piercing die *S* is finished as shown. The round piercing dies were not made in the usual way. They were two hardened, ground and lapped bushing *T T* forced into counterbored holes in the die. After drilling and tapping the holes for the stripper plate screws *L L*, and letting in those for the two-gage plate dowels *M M* and the stop-pin *O*, the die was hardened and tempered in the usual way, drawing it to a light straw.

The construction of the punch is also slightly different from the general practice. The holder *E* is of cast iron with the stem to fit the press plunger and the face finished square and true with it for the machine steel pad *F*, within which the oblong piercing punch *H* and the blanking punch *G* are located. These punches are roughed down in the shaper and are sheared into the die and finished with a file. They are both hardened and drawn to a dark-blue temper and are let into the pad and upset or riveted at the back, as shown. The piercing punches *K* are of Stub's wire of the correct gage to fit the dies. They are located within shouldered sleeves *I*, which are in turn located within the pad in reamed holes, the heads of the sleeves shouldering down into counterbores. The pad in which the punches are located is fastened to the holder *E* by six flat head-screws not shown. The construction of the small piercing dies and punches as shown allows a change, to pierce holes of different sizes in the blanks, with very little trouble. The use of hardened and tempered Stub's wire lengths for the piercing punches is satisfactory and economical, as when one snaps another can be made ready and substituted for the old one in very short order. The same thing can be said of the use of hardened, lapped and ground bushings for the piercing dies, as when one becomes chipped or sheared another can be subsituted with very little trouble.

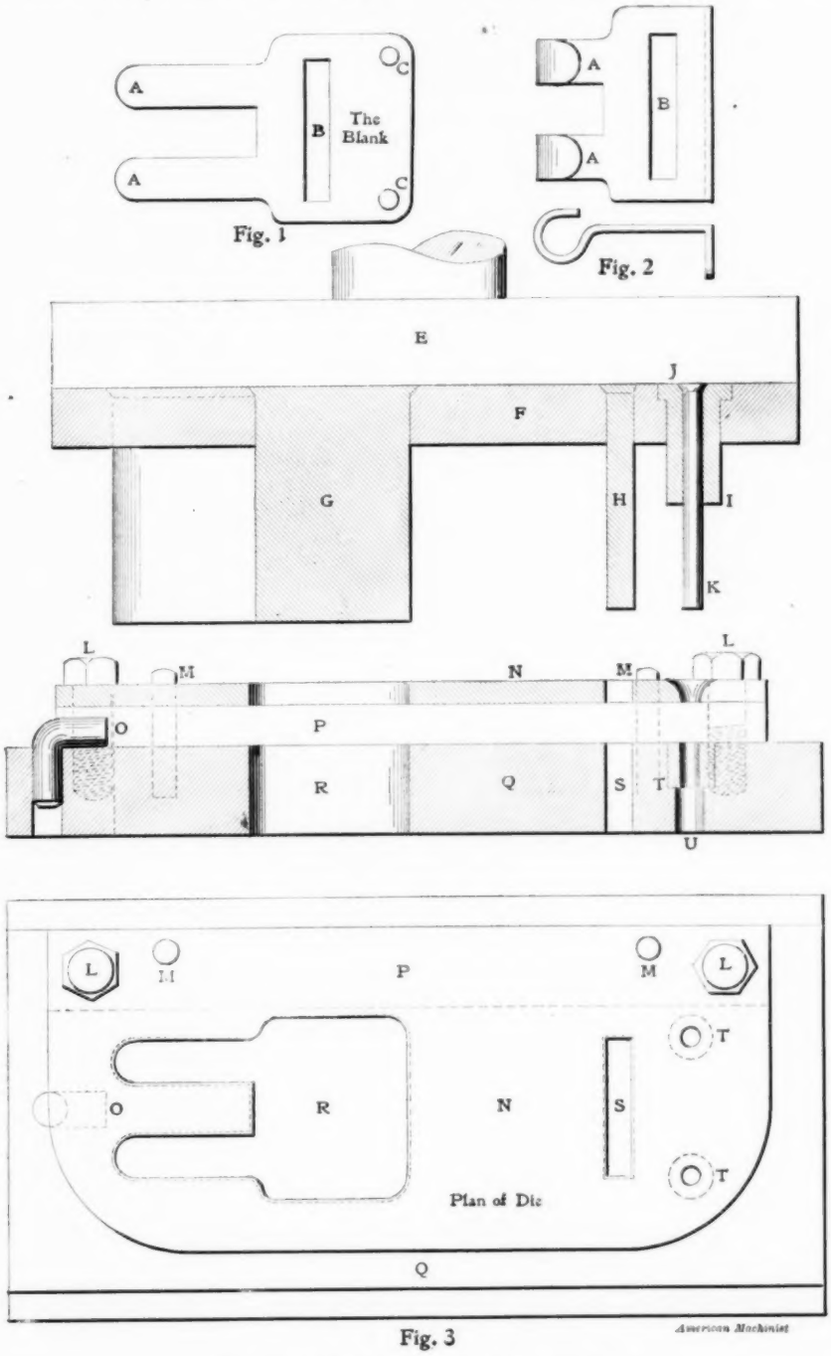


Fig. 3

PIERCING AND BLANKING DIE AND THE WORK.

The punch and die for forming the two extensions *A A* of the blank to the circular shape shown in Fig. 2 and bending the end at *C C* at right angles in one operation are shown in Fig. 4, and, as it shows a novel and rapid method for accomplishing the results desired, it is worthy of attention. It is no simple job to bend and form a blank to the shape shown in Fig. 2 in one operation, but by means of the die shown it was accomplished. The principle of constructing the parts for forming the circular portions of the blank is somewhat similar to that shown in a previous article entitled "Dies for a Sheet Metal Ferrule," page 1407, Vol. 24, but the application of it and the results accomplished are entirely different.

The first part made was the bending die proper *P*, Fig. 4. A piece of annealed tool steel, about 2 inches square, was first planed all over and finished with a dovetail at *S S* and a semi-circular channel was milled across the face at *P*. The die was then finished at *Q* for the right-angle bending portion and the face was finished with an oblong raised portion at *K* for locating the blank, as shown in the plan view of the die at *M*. The working surfaces of the die were then nicely finished and polished, after which it was hardened and drawn slightly.

The punch *I* was now got out of a square chunk of annealed tool steel which was first squared all over, finished as shown at *F*, and a hole drilled and tapped in the exact center of this portion for the threaded end of the stud Y. The piece was now held in the miller vise and the shape required was worked out on the face with the por-

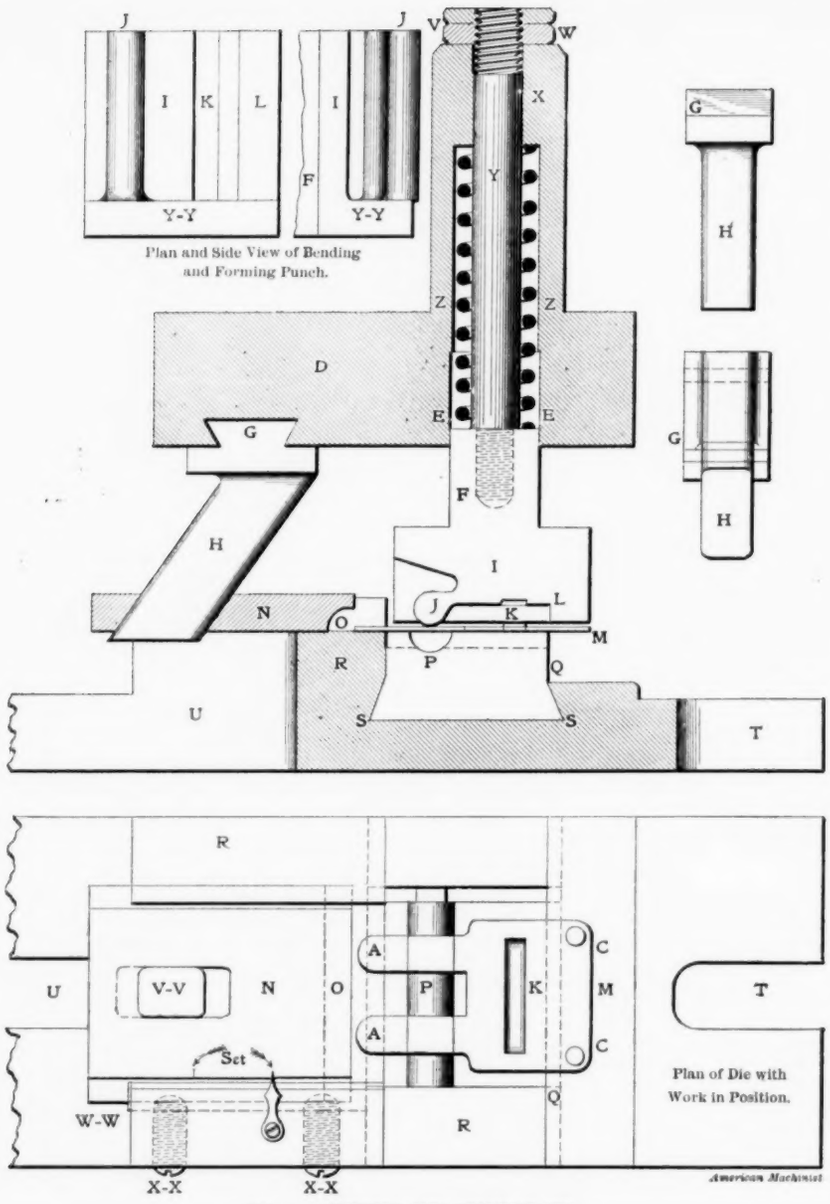


FIG. 4. BENDING AND FORMING DIE.

tion *J* to a radius one thickness of metal smaller than that of the die at *P*, and at *L* also for the right-angle bending, allowing space for one thickness of metal. A clearance way for the locater on the die face was let in at *K* with a butt mill. A stiff supporting wall was left at the back of the punch at *Y Y*, as shown in the plan and side views in the upper left-hand corner of Fig. 4. This wall was necessary because of the odd shape of the portion *J* of the punch. All cuts run out in a fillet at the supporting wall, so as to increase the strength of the punch as much as possible. After finishing all portions to size and as smooth as possible, the punch was hardened and drawn entirely down at *J* and to a dark blue at *L*.

The next portion made was the forming slide *N*. This was planed on top and bottom to the thickness, the sides were finished dovetail and the forming face *O* made a quarter of a circle to the same radius as the die *P*, using in fact the same mill to accomplish it. An inclined hole was then let through the slide at *V V* to an angle of 35 degrees with the slide face, leaving the corners round, and finishing the front and back working surfaces as smooth as possible. The slide was then hardened all over and drawn to a dark straw temper. The forming face *O* was lapped and the dovetailed sides were ground true and at dead right angles with the forming face *O*.

We were now ready for the bolster. This is shown at *R*. It is of cast iron, and after being planed on the back was machined at *S S* for a driving fit for the die *P*, and at one end to admit the forming slide and an adjusting gib, as shown in the plan. This done, and two headless set-screws let in at *X X*, *X X*, the die proper was complete, and the various portions were assembled as shown. A clearance hole was cast through one end of the bolster at *U* for clearance for the inclined slide stud *H*, and also for a fastening bolt for locating it on the press, the bolt at the opposite end being located at *T*.

The punch and inclined stud holder *D* is a mild steel forging. It was first chucked and a hole bored through the stem at *X* for the punch stud *Y*. This hole was then counterbored to the diameter shown at *Z Z* for the punch spring. In diameter this hole was the same as the width of the punch at *F*. The holder was removed from the chuck, an arbor was forced into the hole in the stem, the stem was turned to fit the press plunger, the back was squared, and the front faced. The holder was next set up in the vise of the milling machine by holding the stem within V-blocks, and a square-bottomed channel was let in at *E E* central with the hole *Z Z* and in width a nice fit for the portion *F* of the punch. The distance from the center of this channel to the center of where this inclined stud was to locate was found, approximately, and the dovetailed channel was let in, all at the one setting, by means of an angle cutter and the vertical attachment.

The inclined stud *H* is shown in two additional views at the right in Fig. 4. It is of tool steel, and was first roughed down all over, to somewhere near the shape and size required, and then finished at *G* in a shouldered dovetail to drive tightly into the dovetailed channel in the holder. It was driven into this channel, the holder was fastened in the shaper vise, the face lined and squared with a surface gage, and the inclined stud at *H* finished with the sides at the same angle with the face as the hole in the slide plate *N*. The corners of the stud were rounded and the sides draw-filed to a smooth finish, after which it was hardened and drawn to a dark blue for the distance of the working portion, and the temper allowed to run out for the remainder of its length. After the punch stud *Y* was got out and finished, with one end reduced and threaded to screw into and shoulder down on the punch at *F*, and the other end threaded for the adjusting nuts *V* and *W*, all parts were ready and were now assembled as shown.

The manner in which the forming and bending of the blank, Fig. 1, is accomplished can be understood from the sectional view of the punch and die in Fig. 4, which shows the blank in position at *M* on the die *P*, it being located by the locater *K*. The inclined stud is within the slide, and as the punch descends the portion *J* bends the two ends *A A* of the blank into the die *P*, which causes them to spring up clear of the forming slide *N* at *O*, at the same time the portion *L* of the punch bends the opposite end of the blank down over the edge of the die at *Q*. As the punch *I* bottoms on the die it remains stationary while the holder continues to descend, and with it the inclined stud, which causes the forming slide to move

inward and form the ends *A A* over the punch at *J*, thereby finishing the ends to the shape shown in Fig. 2. As the punch rises the tension of the spring in the holder is sufficient to keep the punch *I* stationary until the forming slide has been moved back out of its way by the inclined stud *H*. The punch then rises and the finished work rises with it, and is slid off from the punch by hand.

This punch and die can be operated very rapidly, and when once it has been set, it is impossible to produce anything but good work in exact duplication. I do not think that the results accomplished by this die in one operation could be attained by any other means in as simple, practical and inexpensive as well as rapid manner, and as such I think the design and method of construction could be adopted to advantage for the rapid production of a large variety of bent and formed blanks of the type shown, which it is impossible to produce in one operation by the more common types of dies.

The Military Experimental Work of a Government.

BY GRAHAME H. POWELL.

From the number of letters received in the executive departments of the government, addressed in every conceivable manner, from the one to the President of the United States to that for the Secretary of the Inventors' Department, there is apparent a good deal of popular misconception as to just who conducts the military experiments of the government and the methods employed.

Up to a few years ago, practically all of the military experimental work was conducted by the Ordnance Department of the Army, one of the technical staff bureaus of the War Department. Without going into the full history of the case, it may be said that an impression gained ground that inventors were not fairly treated by this branch of the government and that the credit and rewards for meritorious military inventions were not always promptly forthcoming. However this may have been, the impression was credited to the extent that along in 1887-1888 the fight was carried into Congress and the cause of the American civilian inventor there championed by the recently re-elected Senator from Maryland, Hon. Arthur Pugh Gorman.

The result of this agitation was the creation of a body of experts to be called the Board of Ordnance and Fortification. This board was composed of the Commanding General of the army, *ex officio* president of the board; an officer of engineers, an officer of ordnance and an officer of artillery, thus representing each of what might be called the technical branches of the army, with the president of the board as the representative of the line of the army. The board was established at a time when Congress was taking the first step in the execution of a project that involved an ultimate expenditure of more than $100,000,000, that of the complete rearmament and defense of our 10,000 miles of coast line; and to the board was left the test of all small arms, cartridges, projectiles, fuses, explosives, torpedoes, armor plates and other implements and engines of war, with a view to the determination of the most effective type of each and their adoption into the service. To quote the late Secretary of War, Hon. Daniel S. Lamont: "Congress knew that every year it would be asked to appropriate millions of dollars for the purchase or manufacture of war material in regard to which all men would not agree. But it determined that when it gave the money it should have every possible guaranty that the articles purchased would be the best of their kind. In other words, it determined that it would not give money to buy anything in quantity until the best type of that thing had been determined by the judgment of experts. For that purpose, and for that purpose alone, it created the Board of Ordnance and Fortification."

In 1891 the board was increased by the appointment of a civilian as a member, the addition being made in order that the civilian interests of the country might be more than ever safe-guarded. This membership remained unchanged in point of numbers, though frequently changed in personnel as the result of retirements from active service of the military members, and so on, up to the year 1901, when by act of Congress two additional officers of artillery were added, making the present membership seven. The addition of two artillery officers was made because of the fact that as our coasts gradually became more formidably equipped, the question of improvements in the service became more and more questions of artillery design and practice.

As the board is charged by law with the test of all "implements and engines of war" with a view to their adoption into the military service, all correspondence on these subjects should be addressed to the Board of Ordnance and Fortification, War Department, Washington.

Congress annually appropriates a sum sufficient to carry on the work incident to the test and development of war material, and the board has constantly shown in the disbursement of these funds a disposition to aid in every way deserving inventors who present meritorious devices suitable for adoption in the military service. This assistance takes various forms, sometimes in the way of allotments of funds to carry on the developmental processes, and at others the purchase of promising designs. No hard and set rule is established. Each case is judged on its merits. Nor does the government insist upon the inventor assigning all, or any part, of his rights in the invention as a preliminary to this assistance. The one essential, however, insisted upon is that the party presenting a device shall submit drawings or description such as will enable a clear understanding to be had of the purposes and objects of the device as well as the means by which they are to be accomplished. One of the objects of this procedure is that time may not be wasted in going over old ground, and, in the case of explosives, for instance, that the compound presented may be known to be safe to handle. This divulgence of an inventor's ideas is, however, protected by the assurance that all papers and data submitted will, if desired, be treated as confidential, so that the application for a patent is in no manner interfered with.

Some idea of the extent of the encouragement offered may be obtained from the fact that in the thirteen years of its existence the board has expended several millions of dollars in purely experimental fields and with the object of developing the inventive genius of the American people.

It must not be supposed from the foregoing that aid is freely given to everyone who applies for it, for such is not the case; in fact, by far the greater number of devices and "inventions" that, no matter how addressed, ultimately find their way to the office of the board, are of the most absurd character and utterly lacking in novelty or usefulness. But such devices, be their character ever so apparent, are not pigeon-holed without an examination by the full board in regular session, and the one who presents the device officially informed of the action taken by the board. As may be imagined, however, the board cannot, nor does it attempt to, point out to each of such inventors the particular fault of his device. To do so would lead to unlimited correspondence with no useful result, for with the man who claims to be able to lift himself from the ground by means of his boot straps, or that the forces of action and reaction are not equal, argument is useless, and this is the type of man who is most prolific as a ready letter writer.

The character and standing of the board may best be seen by a glance at the names of the present members. General Nelson A. Miles, the commanding general of the army, is president and always an interested participant in the deliberations of the board; Gen. George L. Gillespie, Chief of Engineers, U. S. Army, who, under the Secretary of War, is in charge of all the river and harbor improvements carried on throughout the country, represents the engineers; General William Crozier, Chief of Ordnance and joint inventor with his predecessor in office, General Buffington, of the United States disappearing gun carriage, represents the Ordnance; General John I. Rodgers, Artillery Corps, in command of the artillery district at the southern entrance of New York harbor, is the senior artillery representative, which is

further represented by Gen. W. F. Randolph, Chief of Artillery, and Col. J. P. Story, Artillery Inspector of the Department of the East; the civilian interests, while the care of all the members, are more particularly represented by Gen. Thos. J. Henderson, of Illinois, for many years a member of Congress and chairman of the Committee on Military Affairs; Capt. I. N. Lewis, inventor of the range finder that bears his name, while not a member of the board, acts as its recorder and as such is custodian of its files, and the writer as secretary of the board.

Improved Keyseating Machine.

Baker Bros., of Toledo, Ohio, have been improving the large sizes of the Colburn keyseater, and we present some of the details:

Fig. 1 represents what they designate their No. 3½ machine, which will cut keyseats 4 inches wide in cast iron up to 24 inches long in a solid hub, or 36 inches long in a chambered hub. The largest diameter of cutter bar is 3 7-16 inches and the machine will take in work from 88 inches in diameter down. For larger wheels the suporting post can be put inside the rim between the arms.

The upper supporting arm is arranged to swing on the post so as to facilitate the chucking of heavy work and allowing the cutter bars to be made solid and weakened only by the small slot for the shank of the cutter. The detail of this swinging arm is shown in Fig. 2. A sleeve *A* can be moved up and down the column by a rack and pinion *B*, Fig. 1, and clamped in any position by a bolt *C*. The swinging arm fits this sleeve and is located in a definite position by a dowel screw to which is tapped through the arm and enters a hardened bushing in the sleeve. In order that there shall be no difficulty in locating the arm so that the pin will enter the bushing properly, a set-screw *E* in the arm bears against a lug on the sleeve, so that it is necessary only to swing the arm until it is stopped by the set-screw when the dowel screw will enter and lock the arm. Two binding bolts pinch the arm to the sleeve and column, making all rigid and firm.

The pockets for the hardened bushings for steadying the bar are formed between the swinging arm an ' a hinged cover, the cover being held down by a hinged bolt. There are two pockets corresponding to the two positions of the column. The column is located by a taper pin when in the proper position.

The table tilts about the pin *F*, Fig. 1, so that tapering keyways may be cut, and there is sufficient movement provided for a maximum taper of one inch per foot.

Fig. 3 shows a section through the table showing the feed screw and the details of the relieving mechanism for withdrawing the work from the tool on the up stroke. *M* in this figure is a part of the slide which is clamped to the frame; it is bored with a tapering hole in which fits the relieving nut *F*. This nut is split lengthwise and can be drawn into the taper hole and closed to compensate for wear by the collars *C*. The screw *E* is Acme Standard, two threads per inch double, and has the lever *L*, Figs. 1 and 3, keyed to the end. This lever *L* gives a slight turn to *E* at the end of the stroke and causes a corresponding movement of the table. The feed screw is journaled in *E* and is prevented from endwise movement by ball thrust collars *D*.

The work table *K* is fed along by the rotation of the feed screw entirely independent of the movement of *E*. The bronze nut *J* is also adjustable for wear. *A* is a bronze self-oiling backing-up shoe for the cutter bar, and is adjusted against the bar by the set-screw bearing against the plunger *B*. The shoe *A* is cast with an internal oil pocket from which ⅜-inch holes run to the working face. These holes are plugged with soft pine through the grain of which sufficient oil oozes to maintain perfect lubrication.

The automatic feed is operated by the rod *G*, Fig. 1, which gives the shaft *H* a rocking motion at each reverse. The clutch 1 is operated by the handle *J* and connects the large ratchet gear to the shaft. An adjustable stop throws out this clutch when the cutter has reached the proper depth.

The cutter bar is driven by rack and pinion and is reversed by friction clutches driven by open and crossed belts. The stops in the disk *K* serve to operate the clutch and also the feed and relieving mechanism. The feed can be varied from 0.005 to 0.100 inch per stroke by moving the stud in the end of rod *G* in the slot.

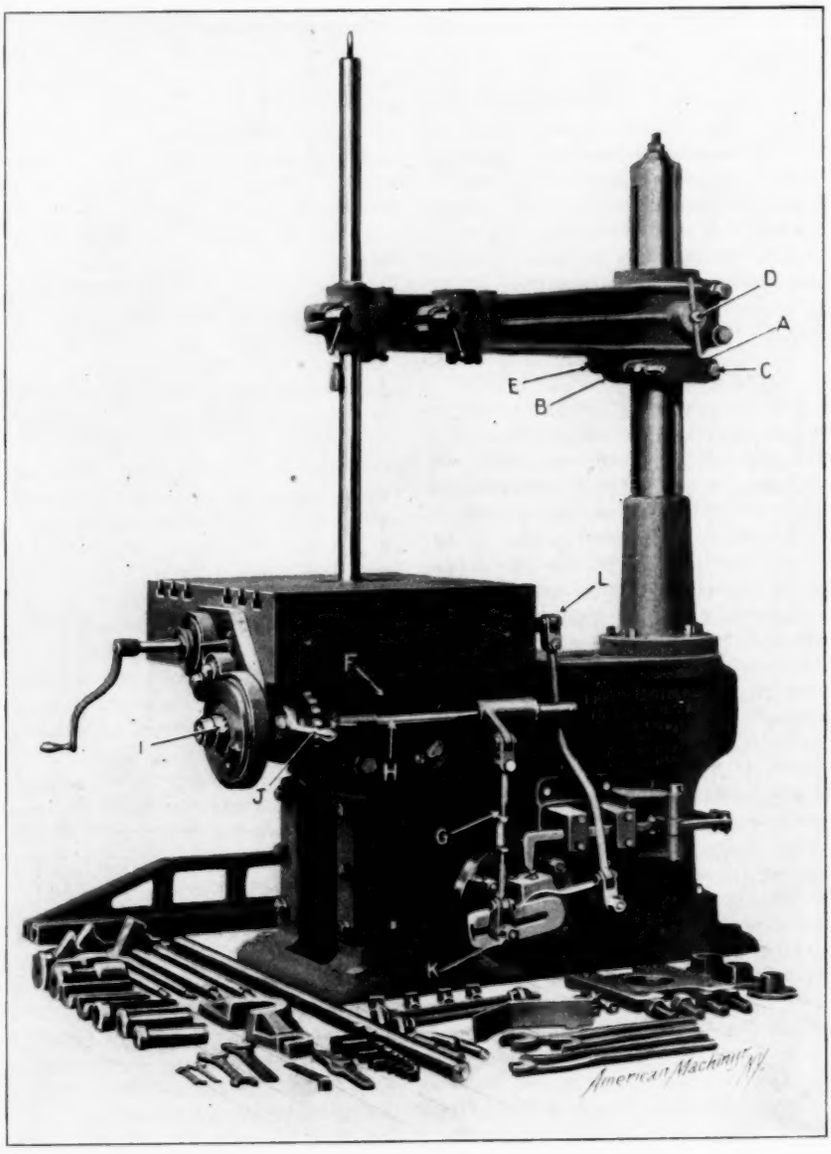


FIG. 1. IMPROVED COLBURN KEYSEATER.

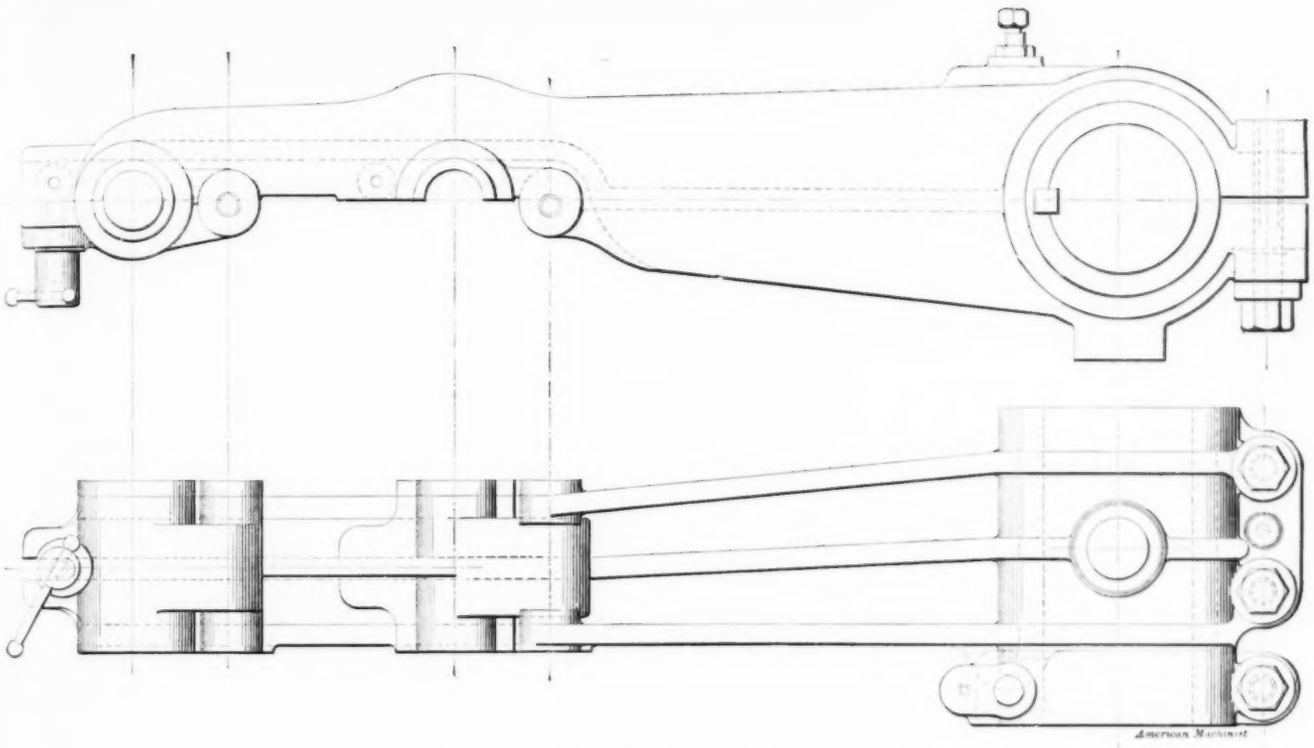


FIG. 2. DETAIL OF ARM OF KEYSEATING MACHINE.

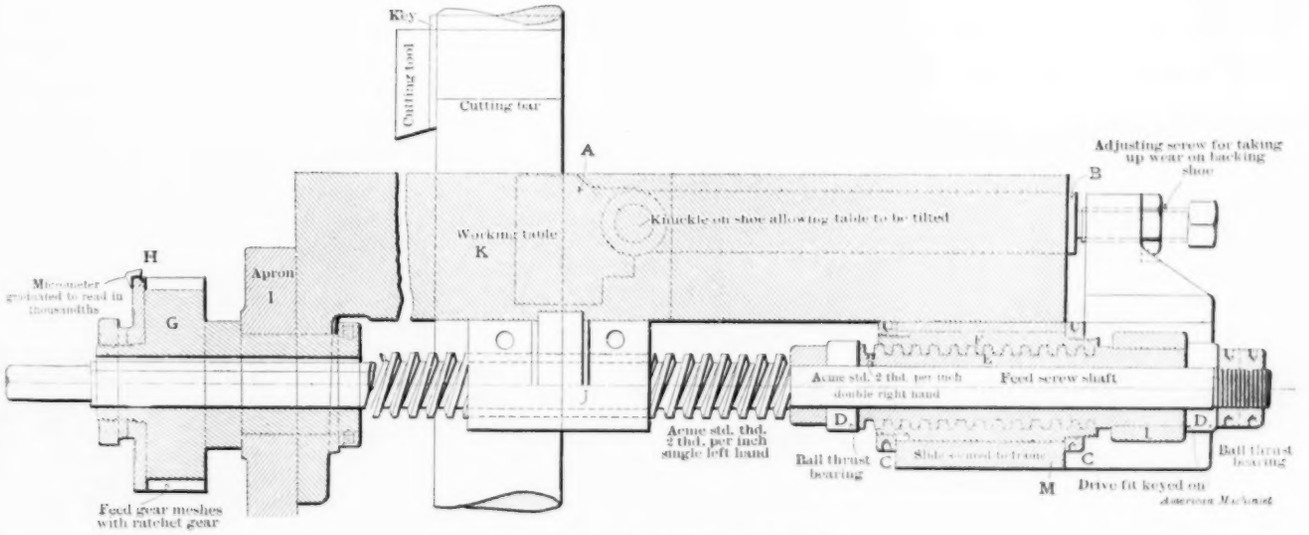


FIG. 3. SECTION SHOWING FEED SCREW.

A Cutting Off and End Finishing Die, and an Accurate Sectional Die with a Chute Feed, and Finger Stripper.

BY JOSEPH V. WOODWORTH.

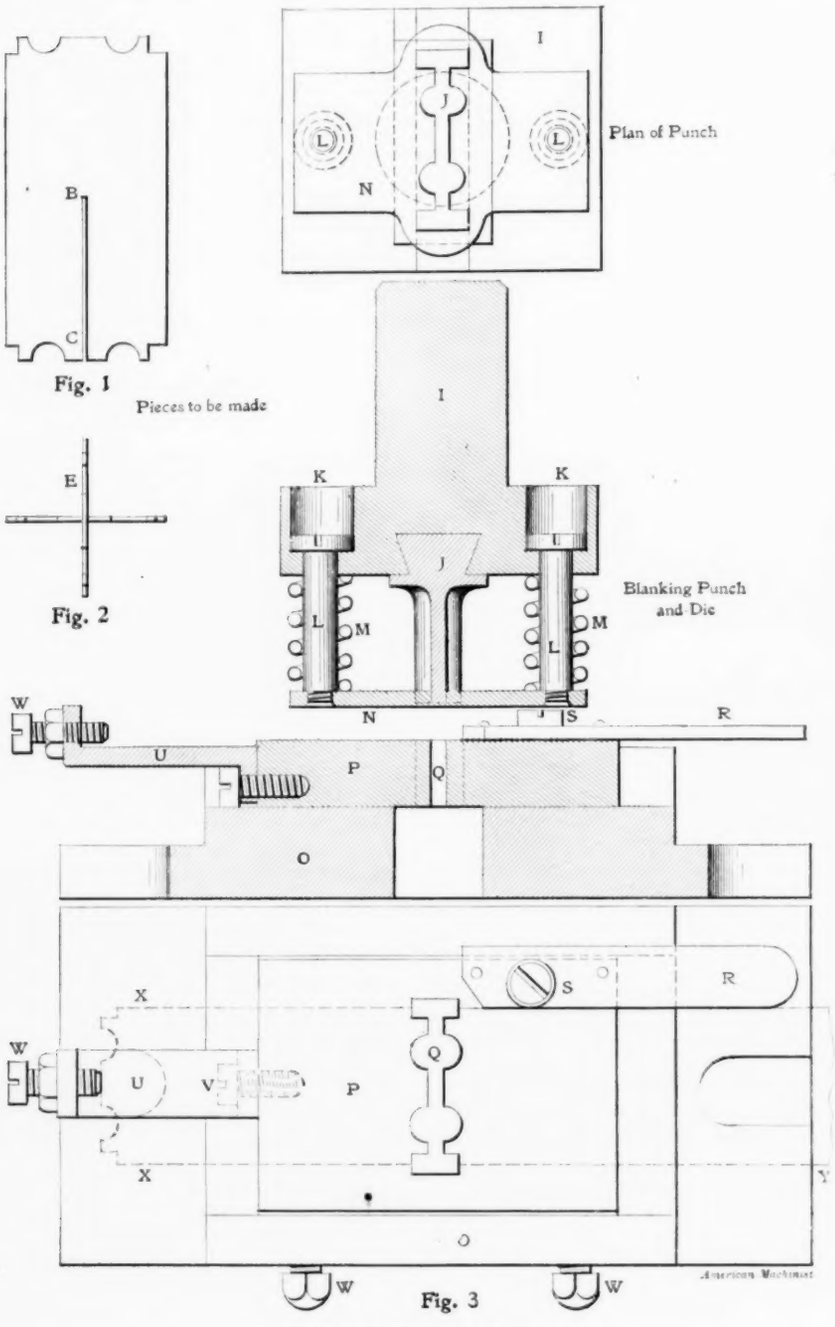
These dies produce the blank, Fig. 1, from a strip of sheet brass 1-32 inch thick. The blanks are to be assembled as in Fig. 2, so that they will be at right angles, to serve as a compartment skeleton for a tin chemical box.

The metal for the blanks came in long strips of the required width, so that it was only necessary to finish the ends and cut them off. The die for this is shown in Fig. 3. The bolster *O* is cast iron. The die *P* is worked out at *Q* to the required shape, the adjustable stop bracket *U* is fastened to one end and gage plate *R* in the position shown in the plan.

The punch is of the usual type, except that the stripper is located upon it instead of on the die. The cast-iron holder *I* has a dovetailed channel for the punch *J*. This punch, after being fitted to the die, is hardened and drawn to a dark blue. The stripper *N* is located by means of the two studs *L L*, which screw into it and shoulder against the face. The stripper studs *L L* and the stripper move up and down, the two springs *M* being strong enough to strip the metal from the punch instantly. The stripper is worked out to fit nicely around the punch so as to prevent the edges of the stock, after being cut off and finished, from bending or burring inward. The press is tilted backward to an angle sufficient to allow the blanks to drop off into a receptacle at the back. The strip of metal is first held against the gage plate *R* and the end is allowed to project a slight distance over the die. This end is then trimmed by the punch, and then the stop-screw *W* is adjusted to get the blank the required length. The stock is now fed against it, and, as the punch descends, the blank is cut off and the front end of the next one is trimmed. As the punch rises, the metal is stripped from it and the finished piece falls off into the receptacle at the back. The rapidity with which the blanks can be produced by this

die should commend the principle for the production of parts of the type shown in Fig. 1. The application of the stripper to the punch, and the use of an inclined press, wherever possible, will increase the output twofold without affecting the duplication of the parts.

For the second operation, that of piercing the long, narrow slot *B C*, the punch and die are shown in Fig. 4. The piercing of a slot 1-32 inch wide to the length shown requires a die of sectional construction, as it would not only be impracticable to make a solid die, but it would be impossible to accomplish accurate results with it. As by the use of this die the blanks are automatically fed to the face of the die very rapidly, and after being pierced are successively picked up to make room for the next, a description of its construction is presented. The die was made first in a single piece, two holes were drilled straight through for the dowel pins *J J*, and the bevel shown was planed on the sides, allowing one side to taper lengthwise one degree. The end at *K K* was milled down 3-16 inch from the face as a locating seat for the feed chute *R*. The holes *P P* and *Q Q* were drilled straight through and two also at *L* for the stop-plate. A narrow cutter was then used to cut the die in two, and the inner edges were finished. These sections *I I* were clamped together face to face with all sides coinciding, and a sharp, square edge milling cutter was used to make a flat, square-ended channel .0163 inch in depth through both of them at *N N*, about ⅛ inch longer than the width of the stock to be cut. The depth of the channel, .0163 inch, exceeded that required by .0065 inch, which was to allow of grinding after hardening. After the notches *M M* had been milled in, as clearance for the stripper fingers, the two sections were hardened and drawn to a light straw. They were then reclamped together and the section face of each was ground until the channel *N N* of die portion was 1-64 inch deep. The two dowels *J J* were then made and entered, as shown. The bolster *O* was now machined, with the dovetailed channel finished so that the die would fit in tightly. The die was entered and fastened, the face was ground and oilstoned, and the stop was fastened by the screws *L L*. The feed chute *R* was made of ¼-inch flat brass, with a channel *S* slightly wider than the blanks to be pierced, the portion on which the blanks were to slide level with the die face. *T T*, the two gage plates for locating the blanks sidewise, are fastened to the bolster instead of the die.



BLANKING PUNCH AND DIE.

The punch consists of the following parts: The cast-iron holder *U*, with a dovetailed channel for the punch pad *V*, the punch *X*, which is located in a square channel in the pad and fastened by the two taper pins at *Y Y*; the stripper plate *D D*, to the face of which are fastened the flat spring fingers *C C*, *C C*, and the stripper studs and springs *F F*, *F F*. The punch *X*, of 5-16 inch flat tool steel, is reduced in thickness, as shown at *Z*, to fit the die, and is hardened and drawn to a dark blue. In doing the hardening great care was necessary, as the frailness of the punch increased the tendency of warping. The stripper studs are let into counterbored holes in the punch pad *V* and the springs are located between the face of the pad and the stripper. The small, blank fingers for picking up the blank after piercing are made from light flat spring steel and are bent to the shape shown and located on the face of the stripper plate. The ends of these fingers project beyond the face of the stripper far enough to allow them, when the punch descends, to be forced upward, encountering the blank and then slipping under it, and as the punch rises they carry the blank with them and, the press being inclined, it falls off at the back.

When in use the punch and die are set up in the press as follows: The press is tilted backward and the die bolster *O* is fastened by bolts through the ends so that the mouth of the feed chute *R* will be directly in front of the operator, and slanting downward toward the back of the press. The punch is then set and the chute is filled with blanks, the first one resting on the die between the gage plates *T T* and against the stop L, the next against the end of the first and so on up the chute. As the punch descends the stripper plate holds the blank tightly to

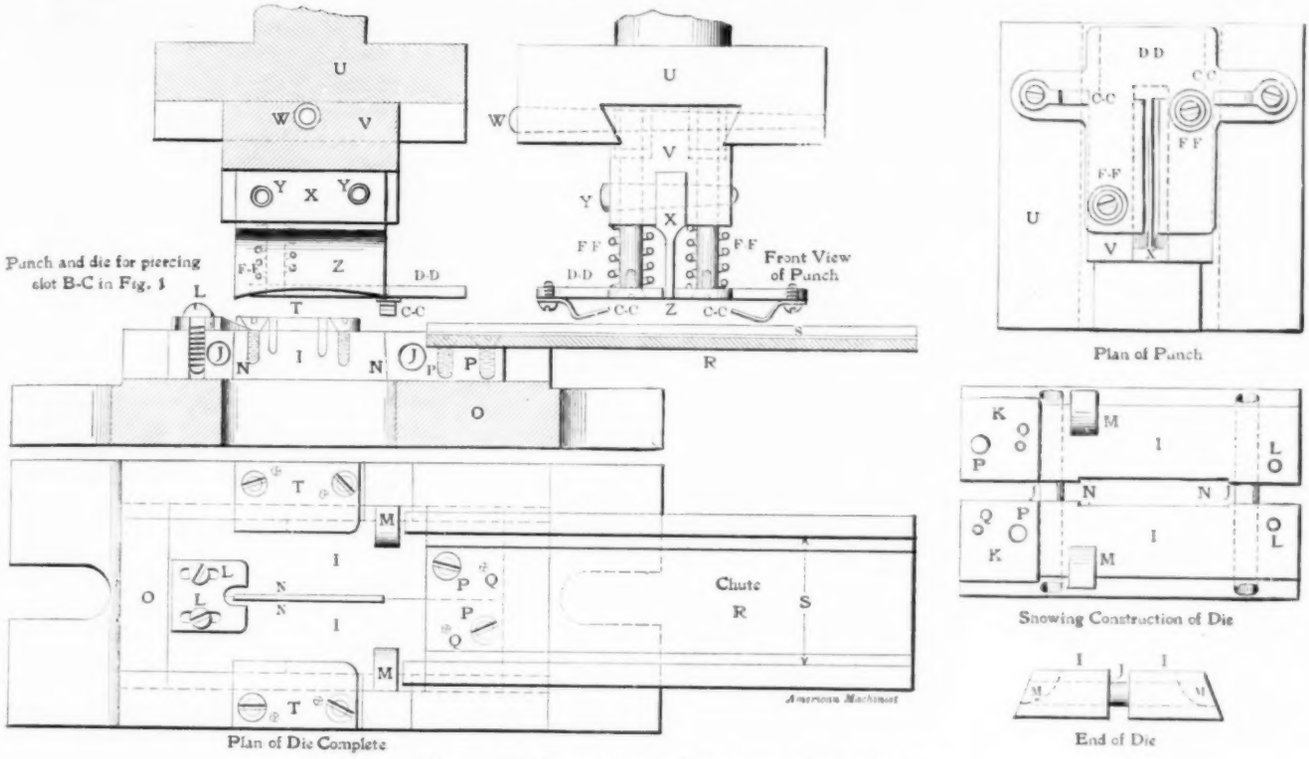


FIG. 4. PUNCH AND DIE FOR SLITTING OPERATION.

the die face and the two spring fingers *C C, C C* slip under it. As the punch begins to rise, the blank is stripped from it by the stripper plate *D D* and is raised from the face of the die by the fingers *C C, C C*, and as the punch reaches its highest point the blank slides off at the back. Using this die the press was run at a high speed and the blanks were pierced as rapidly as the operator could feed them into the chute. There is a large variety of second operation work which can be produced rapidly, accurately, and at a minimum of cost, by dies of this design, with punch, stripper and spring fingers for re

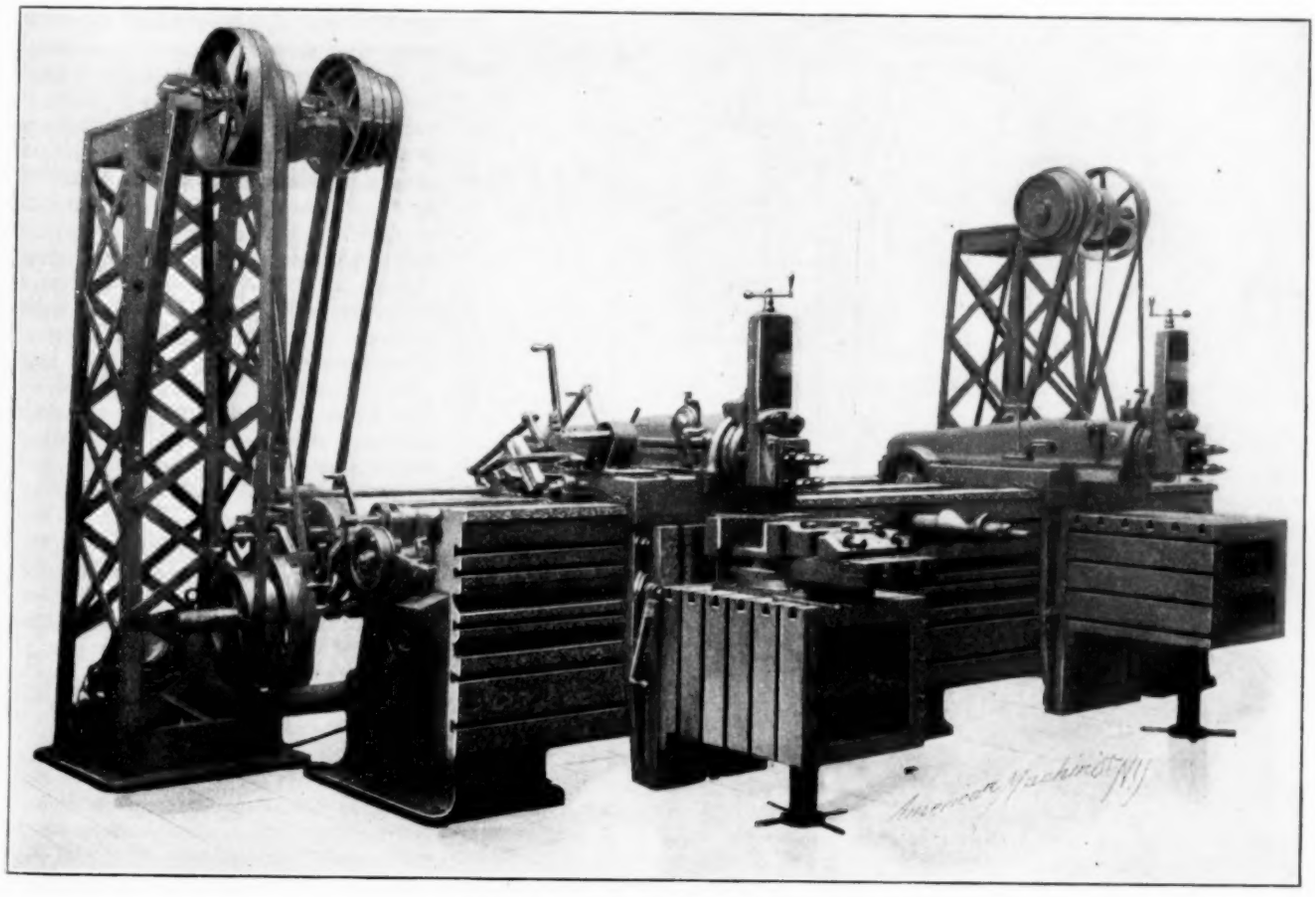


FIG. 1. A LARGE DOUBLE-HEAD SHAPER.

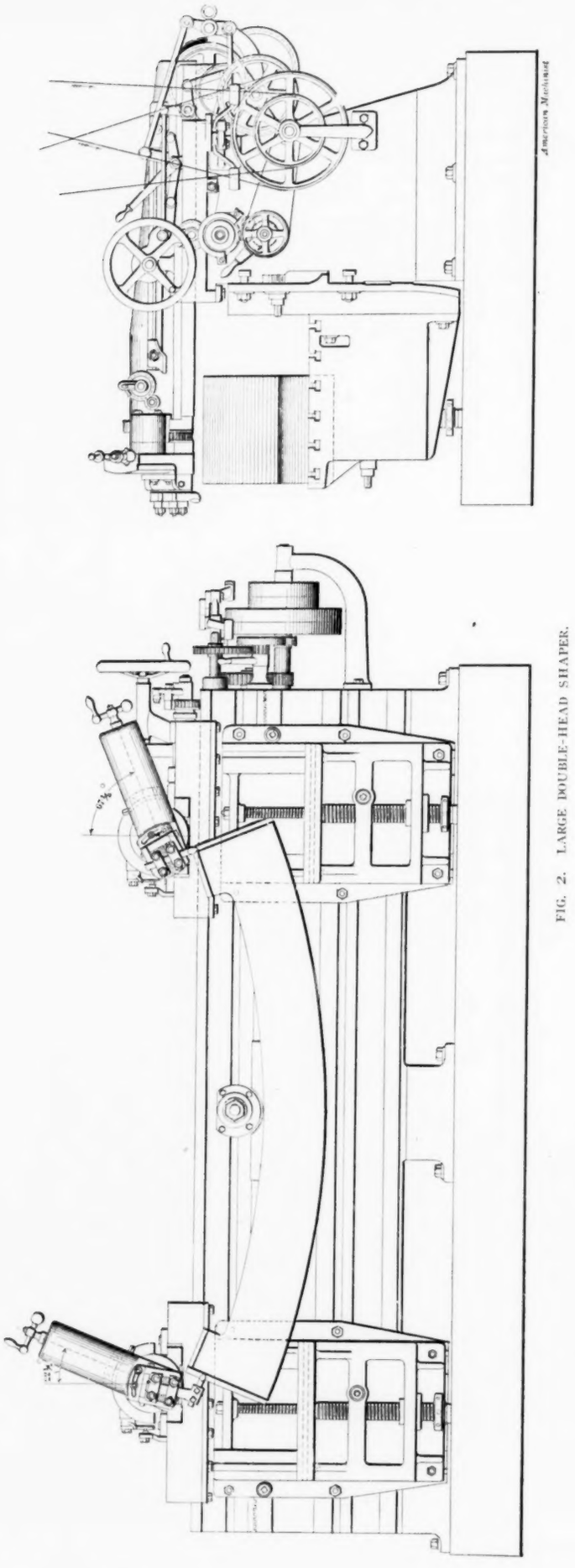


FIG. 2. LARGE DOUBLE-HEAD SHAPER.

moving the blank. The face of the piercing punch *Z* is sheared so as to relieve the strain on it as much as possible.

Large Traverse Head Shaper.

A double-head traverse shaper with a stroke of 30 inches and length of bed of 16 feet presents from its size alone some interesting features. In addition the scheme of transmitting the power from the motors to the machine proper presents one solution of the constantly recurring problem of driving such machines as are necessarily placed under the crane way.

The rams are driven by rack and pinion gearing and shifting belts, the speed reduction being such that there is 74 feet of belt travel to 1 foot of stroke of the ram. The extreme length of stroke is 34 inches and the length over all of the ram is 6 feet 2 inches.

Rapid traverse of the heads is provided for by power, and the down-feed head can be operated by a lever at the side of the ram independent of the handle at the top of the slide. A variable automatic feed to the head is provided and also a worm for tipping the head at an angle.

The tables are adjusted horizontally by rack and pinion movement and vertically by a screw operated from the front of the table. For additional support there are large supporting screws which can be made to take part of the weight of the work and table.

A few dimensions given by the manufacturers will perhaps give the best idea of the large size of the machine and some of its parts: Length of bed, 16 feet; traverse of each head, 10 feet 3 inches; width top of bed, 2 feet 3 inches; depth of bed, 3 feet; vertical traverse of tool slide, 9 inches; greatest distance table to ram, 20½ inches; table top, 2 feet 6 inches by 2 feet 1 inch; width of ram, 13 inches; driving pulleys, 20 inches diameter; width of belts, 2 inches; distance between tools in extreme position, 7 feet 2 inches; weight of vise, 750 pounds; weight of machine, 27,000 pounds.

This machine was designed primarily with reference to a special line of work and Fig. 2 is the preliminary drawing used in securing the order for it. In the figure a segment of a sugar mill gear 14 feet diameter is shown in position for planing both angles simultaneously, and it will be obvious that by transposing the angles to which the heads are set the work can be finished at one setting. The Cincinnati Shaper Company, Cincinnati, Ohio, are the makers.

We have received the rules and regulations of the 1903 World's Fair and the official classification of exhibits. The latter shows thirty-five classes of machinery in five groups—steam engines, various motors, general machinery, machine tools and arsenal tools. For copies address Director of Exhibits, World's Fair, St. Louis.

Letters From Practical Men.

Seen and Heard Around New York—A Crane for a Chuck—Time Wasting Operations.

Editor American Machinist:

A few days ago I saw an example of what I would call the acme of misapplied genius and misdirected effort: a pendulum watch. It bore the legend, "this watch was invented by this firm." This may have been a precautionary measure to prevent libel suits from other firms who might be accused of perpetrating it. There were two sample watches, one with one pendulum and the other with two. We have long been advised of the futility of supplying a dog with two tails. Two tails would not necessarily put a dog out of business. He would still be able to do business as a dog—probably, however, at a slight disadvantage, having the extra member to be trod upon and to have cans tied to. When you put a pendulum on a watch you put it out of the watch business entirely. I suppose the geniuses who invented this twentieth century marvel feel that they have filled a long-felt want.

In the shop of L. T. Weiss in Brooklyn, among many ingenious and clever things, I saw a device (see sketch) for handling a planer chuck. It struck me as about the right thing in the right place. It is always ready, not in the way, is quickly handled and don't slam the chuck down after you have cleaned it off on the bottom and shake out a lot of chips to get under it.

The cost of making the rig amounts to very little. A cast bracket to go on the housing of the planer, a piece of 1 inch cold-rolled steel bossed up on one end for the screw hole and a right-angle bend at the other, a ½-inch screw, a nut with a convenient handle and two pieces, ¼ or 3-16 inch by 1½ or 2 inches. The chuck stays on the crane when not in use, as it takes up no room that can be used for anything else. It keeps clean and does not get battered up with bolts, straps, wrenches, etc. I don't see why this would not be an excellent idea to apply to a lathe also, letting the chuck hang at the back of the headstock. You will see most machinists drop a lathe chuck good and hard, thread side down, so that if there happen to be any chips in it there will be no mistake about getting them well distributed in the thread. The device described is so simple and inexpensive, and so thoroughly practical that it does seem strange that we have gone along all these years smashing fingers and cussin' heavy chucks.

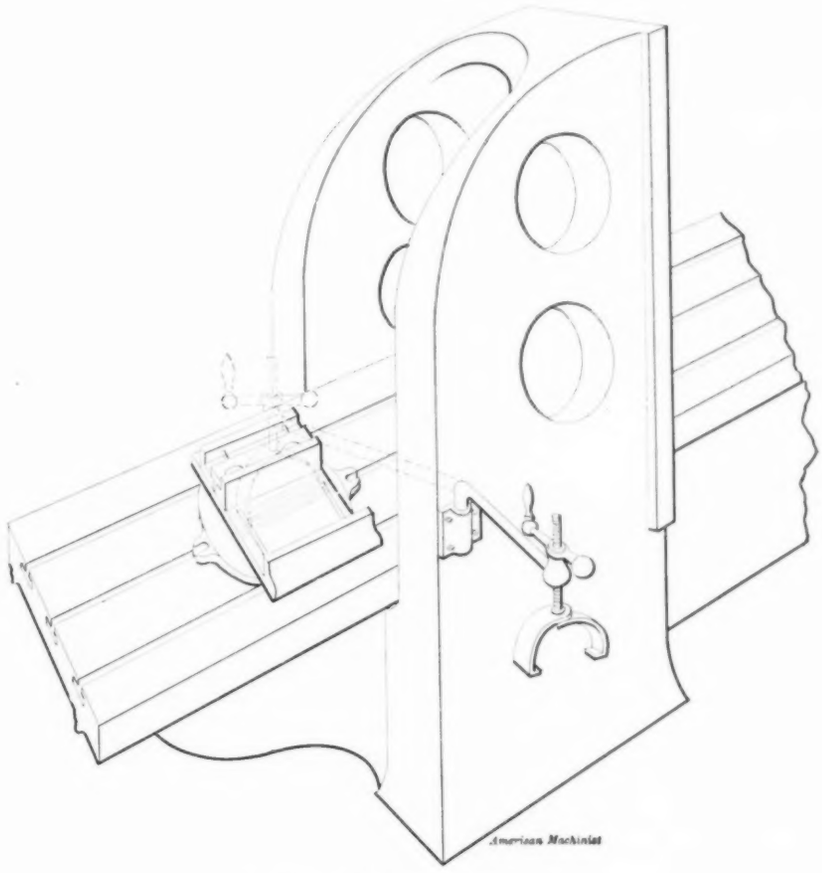
I also saw the hinge die described by Mr. Weiss a couple of years ago. It is now running 115 per minute instead of 30, at which it was at first started, and even now it does not seem to have reached the speed limit.

I was in a shop uptown where they have an up-to-date equipment of fine tools. They make jigs and tools as fine as you will find in a day's travel. While talking to the foreman in the toolroom, I saw a man go to the Brown & Sharpe universal grinder with a big husky looking lathe tool to grind. I expected to see the foreman go after him with a club, but he did not. I saw more men do the same thing. I had a few thinks to myself.

The next thing that attracted my attention was a man who started to cut off a piece with a hacksaw. The saw seemed sort o' slippery, so he went at the saw with a file. I "suffered" a little harder and found it was a Stub's hacksaw. I asked the foreman why? He said: "We use the grinder because we have nothing else in the toolroom. Why we use the hacksaws I don't know." Over in Jersey I visited a shop and saw them draw nice brass shells on a press, and then trim them by a cut-and-fit-and-try method on a bench lathe with a hand tool. It was taking twice the time to trim the shells that it would have taken to make them complete from the bar on a screw machine.

Here was a foreman who needed splitting up (with apologies to Mr. Tecumseh Swift) if ever one did. He was trying to do everything for everybody, and as a result there were from three to a dozen hands waiting all the time for him to fix this or set up that, or test something else, etc. He confided to me that the "boss" told him he couldn't see how he did it all. I thought the "boss" needed some new glasses, so that he could see how he did not do it.

W. A. WARNEAU.



A CRANE FOR HANDLING A CHUCK.

Two Gas Engines Belted to the Same Shaft.

Editor American Machinist:

We were consulted recently by one of our large planing mill companies, who were about to increase their power plant, as to the best way to connect their second gas engine. The mill had been driven by a 60 horse-power gas engine, which, by the increase in the number of new machines added, had become of insufficient power, and they had decided to put in another gas engine of 50 horse-power. The mill being so arranged that it was hardly practicable to divide the load, we advised belting both engines to the main shaft, which plan was adopted, against the advice of the firm of engineers who sold the engines, they claiming we would break a crank shaft or what not, as there would be an unequal pull in the two engines. Both engines were rigged with friction clutches, so that either or both could be thrown into service. We figured the required speeds for both engines when running light, adjusted the governors accordingly, put them both to pulling the load, and they have been running over a month now entirely satisfactorily, giving the entire mill a very uniform speed with ample power. A generator of about 250 16

candle-power 110 volt light capacity, belted from a countershaft running a series of saws, etc., has since been added, and it shows a variation of less than 3 per cent. in voltage, which we consider very good for hit-and-miss governed engines belted as this generator is.

The engine salesmen have since taken off their hats to the job.

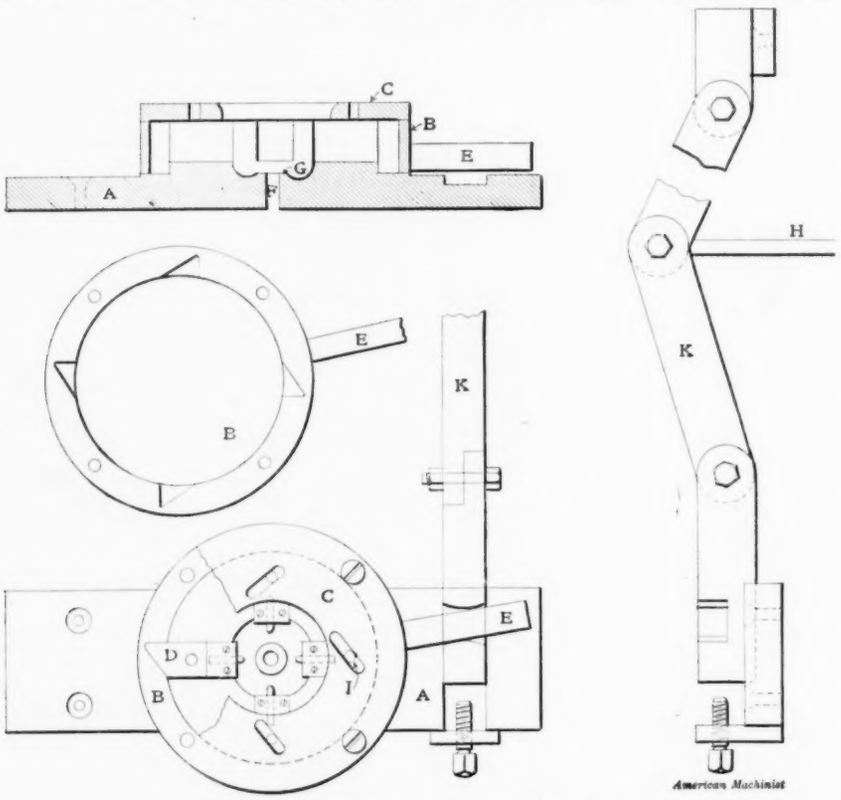
FRED C. TYGARD.

Pittsburgh, Pa.

Punching Holes at Right Angles.

Editor American Machinist:

I have examined with considerable care the device for punching four holes at right angles by Mr. Leech, on page 1355, in a vain search for the die, and have come to the conclusion that the job is one of those very rare ones where conditions admit of the die being dispensed with, for I think it will be found that the great majority of jobs of this kind require the support of an internal die. [The plunger which filled the cap to be punched formed a very sufficient die in the case referred to.—Ed.]



PUNCHING HOLES AT RIGHT ANGLES.

The sketch shows a fixture designed for work of this kind, the construction differing somewhat from that of Mr. Leech, provision being made for a die and for disposing of the scrap. *A* is the die bed, the upper part of which is circular in form and has four radial slots to receive the punch slides *D*, which are beveled on the ends as shown, and are moved forward by the partial revolution of the ring *B*, which surrounds the circular portion of *A* and are drawn back by the pins *I* working in slots in plate *C*, which is fastened by screws to top of ring *B*. *B* is moved by links *K* acting upon stud *E*. Rod *H* extends downward to a treadle, and a helical spring from the treadle to the under side of the bench brings everything back to the starting point. Ring *B* is shown separately. No press is required for this device, as it can be screwed down and operated wherever there happens to be a square foot of bench room. *G* is the die seat and *F* is a hole to receive the die and allow the scrap to escape. "NEEDLE."

Habitual Obstructionists.

Editor American Machinist:

How much easier it seems to be for some persons to find reasons why a thing cannot be done than why it can be done! I allude here to the disposition on the part of many shop foremen and heads of departments to stand off and argue and drum up reasons or excuses why a thing is not done or cannot be done as wanted or when wanted. Every superintendent or shop manager has from time to time had just such men to contend with, men who are employed to act as foremen, and who, if they know their business and wish to be valuable men, expected to execute the orders of those in general charge of the plant, would do all in their power to push forward that which is given them to do, and which must take precedence in order to live up to orders from the office.

Usually the heads of departments around a manufacturing plant do not own it, but to hear them talk one would get the impression that they are the whole thing, and that the only thing the office, or perhaps, properly speaking, the owners, ought to do is to furnish the money and say nothing. I believe that in three establishments out of five which employ from three to five foremen each, if the manager attempts to push through a piece of work ahead of some previous orders, he will find an average of at least three foremen in each of the shops who will attempt to block the way by all manner of excuses and reasons why.

One of the reasons most frequently given is that some other foreman has not done his part, and that he can do nothing until these parts are furnished, while nine times out of ten there will be dozens of things that he could do that pertain to his department alone. We hear much of how "the poor foreman's position is no bed of roses." When it comes to that, where is the man who has to work at all who has even a fairly comfortable straw bed. It is my experience that one's bed is largely of one's own making. Running a manufacturing plant is very much of a chasing match at best, commencing with the business manager, who starts at once for the superintendent, who in turn must go for the foreman. This, however, need not necessarily be an unpleasant thing, if each in turn will consider it his place to obey orders and at once set about doing his best and leave off stating excuses until he has failed to accomplish the things asked of him. Then, if reasons are asked, he will probably have something to offer that will be sufficient to excuse him from all blame.

In a large majority of cases it is next to impossible to accomplish the things asked by the office in the way and in the time given. This, however, is no reason why everyone should not go at the work with a will and a determination to do all possible to accomplish the task et before him. Nothing can be gained, but much valuable time is lost by frequent arguments as to why things cannot be done. A foreman who persists in so doing should either at once turn over a new leaf or promptly resign; for he who thus keeps a superintendent constantly on the lookout for a man of a different disposition is sure sooner or later to be compelled to step aside.

When a man cheerfully sets about doing to the best of his ability the work set before him, and sees that all over whom he has charge do their duty, he should receive that recognition for which he is looking and perhaps seldom gets—namely, increased pay. The fact is that the law of supply and demand seems to have little or no effect on the compensations received by heads of departments. B. W. T.

Beeswax in Cutting Threads on Copper.

Editor American Machinist:

I notice several suggestio. s in your paper recently regarding the use of beeswax as a lubricant for cutting tools.

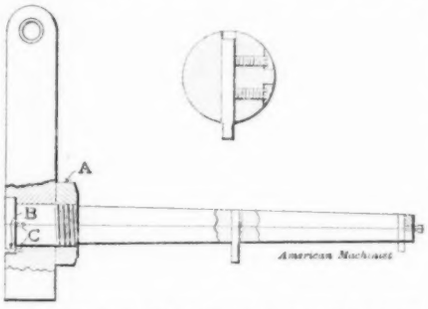
I will say from experience that beeswax is a perfect lubricant for cutting threads on copper, the wax being simply rubbed on the thread. This kink was suggested to me by the superintendent of a shop I worked in a number of years ago, after other means, and patience also, had been exhausted in the attempt to get smooth threads on copper.

Troy, N. Y. JOHN KOEHLER.

A Tool for the Shaper for Internal Work.

Editor American Machinist:

The accompanying sketch shows a tool holder for doing internal work on the shaper which I consider preferable to the one shown by Mr. Morgan at page 25. The bar is a good working fit in the apron and the nut locks it up tight, besides giving it some additional stiffness. If the counterbore in the apron is large enough, the nut may be on the inner end and be



ANOTHER TOOL FOR INTERNAL WORK ON THE SHAPER.

fastened with a spanner wrench, the hexagon nut *A* on the outside being replaced by a solid collar on the bar. There can be several square holes for cutters of different sizes. Ours were made of Mushet steel ground on the ends only. Two ways of holding them are shown. The thread on nut *A* should be as fine as practicable, so as to keep the diameter of the bar as large as possible at the shank end.

The pin *B* and holes *C* are for locating the tool perpendicular to the table, or 90 degrees either side. If used either side of the center the apron must be bolted down or it will lift on the back stroke and break the cutter point. W. H. B.

A Liberal Shop Proprietor.

Editor American Machinist:

There is a machine shop in Uncle William Penn's Quaker City—not such a small one, either—where for several years past a Christmas present to the tune of about a quarter-hundred has been handed around the shop. There are a few workmen, and no doubt some proprietors who don't believe in Christmas presents, and many a business that could not stand anything near the size mentioned. But when a shop owner goes down into his profits so deeply and with no display he must have much good will toward his employees and deserves great credit. If I should mention the name of this shop it would be recognized by many up and down this country and by some in many other countries. The general treatment of employees is a liberal one. Here we find one of the inducements that cause those who know this Philadelphia shop to say, "Philadelphia is not so slow after all." If you are good at guessing have a try at which shop this is. The advertisement is in every copy of this paper. I hope some bosses who happen to read this article, and who have no other better profit-sharing plan, will figure closely next year and try an extra liberal plan to help their "hands" make a happy start for the new year. E. J. B.

Responsibility for Faulty Tools.

Editor American Machinist:

Roger Haine's question, at page 25, about "Faulty Tools on Good Machines," is answered quite thoroughly by himself. Certainly there can be no reasonable excuse for tools being made that will not clear the turret slide or are so long that they will not pass other tools required in the same operation; but there is another side to this matter. The builders of machine tools expend much time and thought upon the design and construction of their product and usually expect to sell a goodly number of their machines. By the use of special tools, jigs and fixtures the cost of their output is reduced to a figure that insures a profit after paying for designing, drawings, patterns, etc. Individual machines for special work are usually expensive. Special tools for use in standard machines are usually contracted for at a low figure, perhaps to sell the machine, and it is unreasonable to expect to obtain the best possible to be had, under this condition. Furthermore, the instructions furnished with some orders are insufficient to enable the designer to do the job justice, and the samples of work to be produced are such that it is difficult to decide what is wanted, how good (or how bad) the work must be to pass inspection. In the case referred to, was the maker of the tools aware of the fact that the brass pieces should vary no more than .001 inch? Did he know that the manufacturer was willing to take the time required to produce work of this class? Was the sample furnished so made that it impressed one as being a good job or a very rough one? Did it measure some even dimension, or was it such that "any old size" seemed good enough? Did the builders go by these odd sizes and make special reamers and mandrels to produce the tools, when standard sizes would have answered the purpose better? Did the sample have a thread upon it that was neither "V.", United States standard nor Whitworth and just enough taper to make it doubtful whether straight or taper was intended or what the size was to be? If the designer knew these things, did he tell the workman by means of a drawing, or did he trust to that rare art of mind-reading? Many samples received by tool builders look as if they came from a scrap box, and because of unnecessary shapes and sizes the cost of the tools is greatly increased. Probably the case cited was different, but these conditions do sometimes come about. W. R. G.

English Scales—A Japanese Scale—Shop Incidents

Editor American Machinist:

Your first issue of the New Year comes to hand filled with those things that go to make life easier for those of us employed in mechanical pursuits, and the contents, in connection with the new suit and general arrangement make your paper more acceptable than ever, after fifteen years' experience as a subscriber.

"Cynic's" remarks, with their accompanying illustration, "Scale or Fillet Gage?" prompt me to make a few remarks in connection with scales of the make he shows. Here in Canada—so different to what we have in the States—fully 90 per cent. of the scales used are of English make, and many of them are perfect facsimiles of the one illustrated, although they are not all in that deplorable condition. There are other defects, however. Graduated on one side only, as many of them are, they present only two available corners for use, and one of these graduated in such a manner that for short measurements it is practically useless. On one edge for the first 3 inches it is graduated in thirty-seconds; the next ½ inch, sixty-fourths; the next 2½ inches, sixteenths, and the remainder of the 12 inches, eighths. The opposite edge, on those that are graduated on both edges, it starts with 3 inches of twenty-fourths, 1 inch of forty-eighths, and the remainder twelfths, thus giving but one corner that can be used with any degree of satisfaction, and, as frequently happens, one must almost stand on his head in order to read it at all. I never see one of them but I am tempted to cut the useless round end off, thereby making it a little more

SCALE MADE BY A JAPANESE BOY.

efficient, and in going about the shop it is like meeting with an oasis in the desert to meet with or see being used one of our clear-cut, square-cornered, hardened American scales.

The year 1899 and the early part of 1900 I spent doing some engineering work in Japan, the work consisting of the installation of compressed air and electric haulage plants at the coal mines in the Northern Island. There were four different mines at which plants were to be placed, located in four separate towns. In one of these places, a town called Yubari, where I made my headquarters, there was a

small machine shop in connection with the mine, used for doing the repair work incident to such operations. In this shop there were two or three machinists and as many apprentice boys. They had very few modern machinists' tools, among the few they had being some English scales.

I had with me one of Starrett's bevel protractors, over which they grew very enthusiastic, one apprentice boy in particular being very demonstrative in his Japanese expressions of delight over the tool. One day he came into my office and with characteristic politeness, making a very low salaam, by means of signs and a word or two of very poor English informed me that he would like to borrow the blade of the protractor for a while. I cheerfully granted his request, after I discovered what he wanted, which took me quite a while. A few weeks later, when the incident had almost slipped my memory, he appeared once more, returning to me the piece he had borrowed, most profuse in his thanks, and then with a flush of pardonable pride mounting his cheeks he drew forth from beneath his kemona the scale shown in the accompanying illustration, a perfect counterpart of the one I had loaned him. He used it continually in his work thereafter, being very proud of it, as you will no doubt agree with me he was entitled to be. Upon my making some inquiries as to how he had done the work, he pointed to an old hand-power shaper, and as he could not speak English and I could not understand Japanese, further explanation would have been useless.

Mr. Woodworth's reference to the man who attempted to turn a taper by throwing the end of the lathe around, turns my thoughts into a reminiscent vein, as I once had to do with a man who tried the same trick.

Upon another occasion I had received the appointment as foreman of a shop in Eastern Pennsylvania. Before accepting I visited the place to have a look around and find the lay of the land. I noticed they were boring some gear wheels in some of the lathes, and there was a car loaded with finished machinery standing on the track. Suddenly the door of the office opened and the manager of the concern came out and going quickly up to the foreman in a white heat demanded: "Mr. Smith, why is it you have not got this car loaded and shipped?" The foreman replied that he had one wheel to finish boring, after which several of the wheels had to be keyseated. The manager shouted, in a tone that could be heard quite a distance: "Just as soon as you get that wheel bored I want you to get them on the car and have the car taken out of this and send the keyways afterward."

Another illustration of men in positions of authority who have some things to learn occurred a short time ago in the same section of country. The superintendent came up to the foreman with the remark: "Frank, have we a lathe that runs backward to cut threads?" The foreman replied that he did not understand what he was trying to get at. The superintendent replied: "I have received a complaint from Blank & Co. stating that the last screws we sent them were cut with left-hand threads, and I informed them that such a thing was impossible, as we had no machine that ran backwards to cut threads, and therefore they must be right-hand." Ridiculous as this sounds, it is a positive fact. S. B. McQUADE.

Scale Graduations.

Editor American Machinist:

I agree with Messrs. Warman and Cochrane in their article, on page 15, of the "American Machinst," about the graduation of dials, and I think, too, that for some purposes the short lines on a scale would be handier—for instance, when the scale is laid on the work to take a measurement; but when it is desired to set a pair of calipers or dividers by the scale I should prefer the graduations as commonly made. Would not the manner of graduating shown in Figs. 2 and 3 of the article referred to add so much to the manufacturers' price that the users of the scales would be the first to complain?

M. H. BALL.

Answers to "Some Questions About a Die."

Editor American Machinist:

My old friend, Mr. B. J. Dougherty, at page 33, asks me a number of questions as to why the die, described in my article on page 1231, was not constructed according to his methods. The principal reason for not constructing it according to his methods was that Mr. Dougherty was not there. I will now try to answer his questions in order.

First: The stamping punch was made with a hole bored in the center and with an inserted stud, not because it was *impossible* to make it solid, but because it could be finished in half the time that would be required to finish a solid punch, and Mr. Dougherty will find that out if he makes his next punch that way.

Second: The die was annealed in an *air-tight* box in powdered charcoal, to get it soft—not to harden it, as I am inclined to believe Mr. Dougherty suspects. The die remained soft after being annealed and was finished as described without any trouble.

Third: The die *did* come out of the drop in as good shape as it went it, and it was *not* necessary to plane and finish it all over again.

Fourth: The die could have been hobbed in cold by using a press, but the man that made it preferred to do it the other way, just because he did not happen to be one of those men "who would rather sink a die that way than take a day off fishing." He had not worked all his days at diesinking. If he had, perhaps he would have known more about "nice chisels, some scrapers and graving tools to smooth up with." He was only a diemaker, and if he could not use graving tools, still he could make a die for anything in sheet metal; but if it came to a choice between sinking a die and taking a day off fishing, I think he would prefer to fish.

Fifth: The edge of the blank *was* scalloped and not finished round, because on this job it was necessary, notwithstanding Mr. Dougherty's positive assertion that it was not. The shell produced was as the half-tone showed it to be, and not "very pointed at the end of each corrugation," and if it is "up to" me to explain this, I will say that the man who made the die understood the finding of a blank which would allow of the results shown being accomplished.

Sixth: A blank holder was used on that stamping die because after trying it without one, it was found that one was required, and a spring stripper was used on the blanking die because the diemaker thought it best to use one, and the results proved he was right.

Seventh: The shear was given to the die instead of the punch, for the same reason.

Eighth: The clearance given the blanking die was sufficient, and as the diemaker considered himself a "peach" at hardening, he was able to harden that die without having it come out "without any clearance whatever."

JOSEPH V. WOODWORTH.

Allowances for Press Fits.

Editor American Machinist:

At page 27 appears an article on "Press Fits," which to me seems wrong both in theory and in practice. Is it not true that instead of the resistance decreasing with the increased size of the hole, thus needing a greater allowance to make a fit, it —the resistance—grows more and more as the bore becomes larger?

Suppose a shaft 2 inches in diameter were turned and ground .002 inch large to fit a standard hole. This would press in very hard indeed. It would project .001 inch all around and thus give a line of metal .001 inch thick and 6.2832 inches long to be displaced by compression. If the diameter were increased to 30 inches and the same allowance made, a line .001 inch by 94.248 inches would have to be pressed away. It seems from this that instead of such a rapid increase in the allowance made, we should let it remain nearly constant, or even decrease it slightly.

The above instance assumes that the inelasticity of the metal surrounding the hole remains nearly the same. This would be true in castings for flywheels and the like, where all parts are made proportional, the length and thickness of the hub increasing with the bore. For sizes over 3 inches a constant allowance of .001 inch

will give the required higher pressure for all sizes up to 12 inches. This is the experience of one who has done that class of work for eight years, fitting all sized hubs from 2 to 12 inches bore and from 3 to 10 inches in length.

I should think the table given on page 27 would work much better for *shrink* fits with rings. A ring having a large bore and little stock around it will expand and drive on a shaft much larger than it could be forced on if the metal is heavy enough to forbid expansion. Thus I have seen a cast-iron ring with a 16-inch bore, 1½-inch face, 19-inch outside diameter put into a bushing .003 inch large. I fear the result would have been disastrous to the ring had it been forced on anything .031, .019 or .024 inch large as the tables given advise.

Of course, the materials used, the length of hub and the state of the finished surfaces play a most important part in determining the allowance to be made. When a shaft is turned with a fine finishing feed and forced into a reamed hole, the tendency will be for the high spots to force into the fine grooves, and by smoothing down the surface allow more stock to be left on than would be the case were both bearings highly finished and the fit made solely by compression.

I have also seen hundreds of tool-steel rolls manufactured of about 6 inches diameter, hardened, with the hole ground 1¾ inches standard, 4 inches long. These are forced on their shafts by an hydraulic press. And how much larger are these shafts ground? Four and three-fourths thousandths? Two and five-eighths? Those tables before quoted recommend something like that. No, they go on in a good straight hole at 20 tons pressure with an allowance of only .000¼ inch. Sometimes, then, the rolls burst asunder.

Rules can never be hard and fast, but if under the same conditions the hole were increased to 30 inches diameter, having the same proportions in length and surrounding metal, a tenth, twentieth, or even thirtieth part of the allowance given in the tables would require the ram of a battleship or the energy of a 13-inch rifle to force in the arbor even a quarter of an inch. WILLARD H. COOK.

Providence, R. I.

Twist Drill Names and Numbers.

Editor American Machinist:

In my article about marking twist drills, at page 1345, Vol. 24, I wrote: "A ⅜-inch drill is no more a ⅜ drill, but a 24 drill, and a 25-64 drill is no more a 25-64 drill, but simply a 25 drill," but your printers inserted "No." before the figures in my expressions, "a 24 drill" and "a 25 drill," and so spoiled the force and truthfulness of my statement, and opened the way for the very proper criticism which appears at page 13, Vol. 25.

The expression "a No. 25 drill" is never used or meant by us, because it would be confusing, as your correspondent from Cleveland points out; and it would be little improvement on the old way, as we Americans are after condensation and brevity. We really keep the old fractions, but reduce them all to sixty-fourths and then omit the denominators, which are always understood when not expressed, and expressed whenever it is necessary to distinguish them from other drills which go by numbers only.

I can't help wondering who the "outsider" is, referred to by brother Cox—the man who makes or the man who uses the drills? J. C. GREEN.

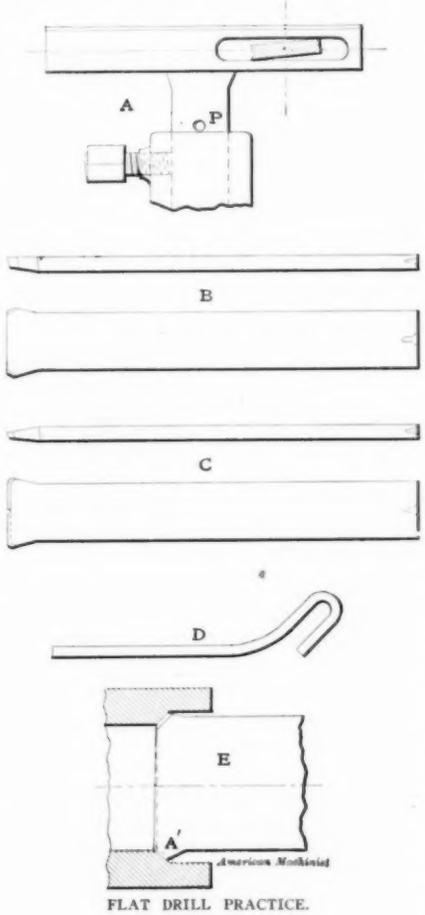
Hackettstown, N. J.

[From some experience in shop matters we cannot help thinking that at some time and with some men it would be quite possible to have a misunderstanding over the use or non-use of the "No." before the numerals, and that some time might be lost or some work might be spoiled in consequence.—Ed.]

Flat Drills.

Editor American Machinist:

On page 1353 there appeared, under the heading of "Foreign Shop Kinks," an article describing a flat drill fixture used for boring pulleys. Flat drills are an old institution on this side of the pond, and are at all times to be preferred to turning tools for roughing out cored holes. I think, however, your correspondent must have been misinformed, when he says that the weight shown in his sketch was for the purpose of keeping the drill flat upon the bottom of the slot, as the purpose of the weight would be rather to steady the drill. The center of the slot should be the same hight as the lathe centers, and, when cutting, the drill would be inclined towards the operator, the rear side bearing against the top of the slot and the near side against the bottom. *A* shows a style of the T-rest much used over here, with a slot for flat drills, the pin *P* being used for setting the hight correctly. It may not be out of place to here remark that the description of cutter used in the boring bar on page 1011 is evidently a variation of this practice.



FLAT DRILL PRACTICE.

Flat drills cost very little to make, and are always handy to have around a shop. I have seen them made from old files, and do good service, too. The sketches *B* and *C* show styles of flat drills, *B* being for roughing and *C* for finishing, the finishing drill being rounded at the cutting edges. The system I have always adopted in making these drills is not very elaborate. Take a piece of flat steel in width under the size of the hole: for a ¾-inch hole say 9-16x¼ inch, and for a 1¼-inch hole 1x5-16 inch. Spread it out at the end, truing it by the eye; file it up to the required size and harden and temper, also drilling a hole for the tail center. When commencing to drill, it will nearly always be found to drill a hole larger than its size, on account of the cutting faces not being equidistant from the tail center. The cutting edge, which is in advance, will run away from the side of the hole, as shown exaggerated at *A'*, and requires grinding back. After one or two trials the drill will cut to size exactly, and the finishing drill will drill a true hole such that the reamer can be entered into truly, and a succession of holes will all be the same size. *D* shows a piece of steel bent up for use as a holder for steadying the drill. In conclusion, I may say that I have used flat taps made up on the same system and used in the same manner as flat drills.

Liverpool, England. J. COOK.

A Diligent and Appreciative Reader.

Editor American Machinist:

Having observed with much pleasure and profit some of the articles contributed to your pages, I have concluded to take a hand myself. Allow me first to take off my hat to Mr. W. Osborne and Mr. Jos. V. Woodworth for the combined philosophy and instruction they have given me. In this category should be included a good many others: "Old Bob," "Ver. I. Nier," A. H. Cleaves, J. L. Gard, L. O. Danse, Isaac Morgan, C. W. Putnam and a host of others. Well, I almost forgot "the noblest Roman of them all," "Tecumseh Swift." The pages of the "American Machinist," through fact and fancy, humor and sarcasm, anecdote and splendid illustrations, can and do prove to be as interesting as any work of fiction. That

bright little bit by "Cynic," page 32, was quite amusing. But, really, fellow contributors, do you think there is anything gained by ridicule and sarcasm? If anyone makes a contribution in good faith, let it go at that. If you have a better way, let us by all means have it; but do not let sarcastic remarks take the "good taste" away. J. V. Woodworth's article in self-defense a few weeks back was very good in this line. I was pleased to see in what good spirit "Drill Hand's" suggestion was received. The article in Vol. 25, No. 1, about private stocks of tools would do a good many small shop proprietors good if they would heed it. Let the foremen put a proper stock of tools in the toolroom and see that they are kept there, and in good condition, and private hoards will be a thing of the past, as they should be. ELMER E. SWEENY.

"Don't Read, It Don't Pay."

Editor American Machinist:

The other day I went into a shop and asked one of the workmen (who, by the way, was a son of the proprietor) if he ever read any and if he would not like to try the "American Machinist" for a year. This was his answer: "I have worked in this shop for fifteen years and can do any job in this or any other shop and don't need to read. Can't learn anything from the papers nohow." While he was telling me all this he was engaged in drilling centers in some short bars of square iron. His center drill was a flat drill about ⅛ inch forged on the end of a piece of ⅜-inch steel about 14 inches long and left full length. The point of drill if left free would have described a 2-inch circle. He was using it in an old lathe which must have been one discarded by Noah, and was running it at a speed of fully 35 turns per minute without any provision for keeping the drill cool.

Of course we will all agree that he could not learn anything—by reading or otherwise. J. E. P.

A Novel Way of Making Small Gears.

Editor American Machinist:

A little kink in gear cutting where one has only an engine lathe to operate with may interest some of the readers of the "American Machinist."

I make a gear cutter from a piece of steel about 2 inches in diameter by ½ inch thick, which I chuck and bore out to fit any convenient arbor. While on the arbor I cut a thread on the blank of a shape to suit the desired tooth, and have found that a 16-pitch thread makes a very nice sized tooth for gears ranging from a ¼ to 1 inch diameter. After the thread is cut to suit care must be taken in fluting the cutter not to have the flutes as wide as the thickness of the gear blanks. My experience has shown that about the best thing to do this with is a fish-back file. When fluted and tempered in the regular way the mill is ready for work.

Now, take a piece of iron that fits the tool-post 5 or 6 inches long and of such thickness that the top when level will be a little below the center line of the lathe. In one end and on the edge drill a vertical hole of the same diameter as the hole in gears and a distance from the end equal to half the diameter of the gear less the depth of the tooth and a fraction over. Place a pin in this hole, allowing it to project sufficiently to pass through the gear blank and allowing it to turn freely thereon.

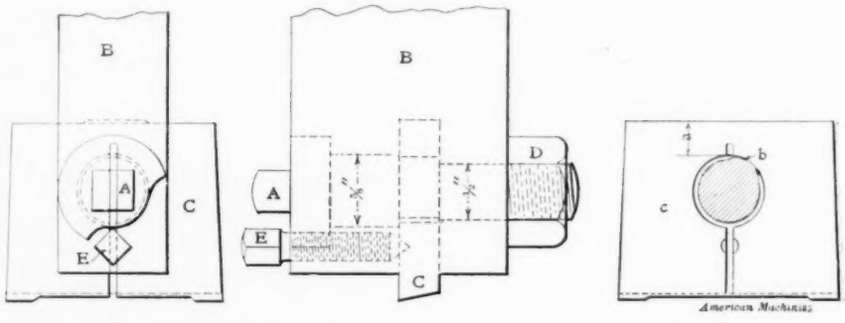
Place the iron piece in the tool-post with the top surface half the thickness of the blank below the center line of the mill. While the mill is running feed in the carriage until the blank on the pin comes in contact with the mill when the blank will start to revolve and will continue to do so. Continue feeding the carriage in until the teeth are deep enough. The number of teeth in the gear will be regulated largely by the diameter of the blank, although by starting in with a deep cut the number of teeth will be decreased and similarly a light cut at the start will increase the number. JOHN GRAVES.

An Improvement in the Planer Tool.

Editor American Machinist:

Since sending the description of a planer tool published at page 1346, Vol. 24, I have used a modified form of the same tool which is superior for standard sizes.

The cutter is the same as has been shown before. The bolt *A* in the sketch passes through the bar *B* and cutter *C*. The portion of the bolt which passes through the cutter *C* is filed away, except at *b*, as shown in section in Fig. 3. The distance *a* in the cutter *C* is made such that when the point *b* on the bolt *A* is in about the position shown in Fig. 3 the top of the cutter is forced against the seat in bar *B*. Tightening the nut *D* clamps the cutter in the bar, and as it tends to turn bolt *A* forces the cutter upward. The bolt *A* projects in front of the bar and is squared for a wrench, by means of which it can be turned to force the cutter upward or release it. The head of *A* is cut away, so that it can make about a quarter-turn without striking the adjusting screw *E*.



AN IMPROVED ADJUSTABLE PLANER TOOL.

When inserting a cutter the point *b* is turned toward the bottom and slipped through the bar and cutter, then by turning *A* in the direction of a right-hand screw *b* carries the cutter upward until it comes in contact with the bar and holds it firmly against it. This makes a tool which is easily adjusted and still very rigid. JOHN SCOTT.

A Correction.

Editor American Machinist:

Kindly correct two misprints that occurred in my letter, on page 24, about "Filing Crank-Pins." The distance between the crank webs was 4⅛ inches instead of 48 inches. In the eighth line from the bottom, it was emery paper, and not calipers, that was used to polish the pin. H. ROLFE.

Centering Long Work.

Editor American Machinist:

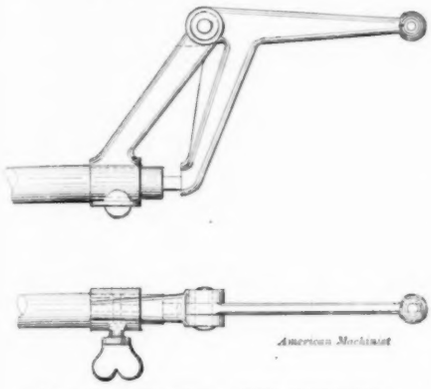
Centering a piece is in general about as elementary a job as there is in a machine shop. Nevertheless, as it costs money and as there are several ways to go about it, I venture to submit the following method, which I have found very satisfactory. I had quite a number of pieces of 2-inch machine steel, about 6 feet long, to center. We had no centering machine, so I took two steady-rests, setting them central and to the size by using a mandrel the size of the stock, and clamped them on the lathe bed, one near the headstock and the other at the right distance for the other end of the piece with the lathe carriage in between them. This of course insured the work being centered by the ends. It was not necessary to bring the top parts of the steady-rests down on the work. To feed the work along, I put in the tool-post a fork derived from a somewhat obsolete square centering device, and a dog on the middle of the piece to be centered. The dog (a straight-tailed one is best) should be placed near the middle of the piece, so that both ends can be centered without shifting it. The combination center reamer and drill of course rotated with the spindle. The advantages of this method are that it is rapid, accurate and very convenient and easy for the workman.

Z. Y. X.

Attachment for a Test Indicator.

Editor American Machinist:

On page 1011 there is a "test indicator" by M. H. Westbrook, of Stratford, Canada, which is a very good one, I know. I have one which I made about twelve years ago, and would not part with it.



ATTACHMENT FOR A TEST INDICATOR.

There are very few that have one or who ever saw one like it. I should like to add a little more to this one, as it is not complete and will not do all that it is capable of doing without the attachment for reaching into holes, which is here shown and which will explain itself.

M. W. LEECH.

A Patternmaker's Tool Chest — A New Demand for Dress Suit Cases.

Editor American Machinist:

To the young patternmaker who contemplates cutting away from the home shop at the completion of his term of instruction and taking to the road in search of experience and wealth, I would say: Leave your tool-chest at home and buy two dress-suit cases to take its place and be free from the gray-hair producing vexations inseparable with the usual massive iron-bound box that a large percentage of our fellow-craftsmen will persist in lugging around with them.

In addition to the cases, if your kit has assumed the standard weight and fineness, you can reserve one large, fat till in your trunk for the tools that are seldom used, being careful to keep the weight thereof within the 150 pounds allowed as baggage by the railroads. Thus, you see, there will be no expressage to pay to anyone, it being understood that you are not above toting the suit cases on either side of you and being pointed out as a drummer with sample cases to burn. OLD BOB.

Finding the Elevation of a Pump Above Its Supply.

Editor American Machinist:

In Mr. Osborne's "Echoes from the Oil Country," at page 5, he describes a method of finding the level of a pump above its supply by using a carpenter's level, a straight-edged board and a pole about 40 feet long.

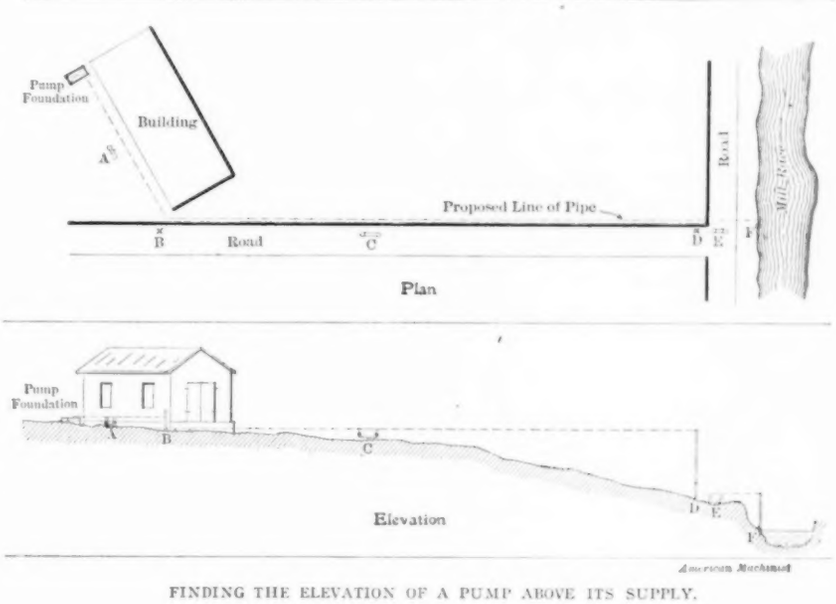
It recalls to me a similar job where the above appliances were not available and where a clear line of view could not be had from the pump to the water supply, and as it is a job that any pipe-fitter is likely to run across it may be of interest to someone.

In this case the pump foundation had been completed and a second-hand pump, purchased in the neighborhood, was ready to be placed. The pipe was on the ground and we were sent for to connect it up, but after looking the ground over with my helper we decided that the location was too high and that it would be useless to make the connection. Too much hard work had been done for us to stop the job with nothing but a guess. We had to have facts and figures and have them quickly and all we had was a pipe-fitting outfit. First we needed a level, so we made one out of three pieces of 1-inch pipe each about 3 feet long and put together with two ells in the shape of the letter U. We filled this with water and each time we used it we propped it up to keep it from falling over and put a wedge under one end until the water was just overflowing at both open ends, thus showing the tops to be level.

In the sketches the letters indicate similar points in both plan and elevation. We placed the level three times, first at *A*, then at *C* and last at *E*. After setting it up at *A*, a point about half-way between the pump foundation and the road, the helper held a 2-foot rule on the foundation and moved his thumb along until it agreed with a line sighted across the top of the level. We have not the exact figures now, but the rule showed the foundation to be about one foot below the top of the level. He then held a piece of pipe at *B*, a point on the road in a direct line with the level, and moved his hand up and down until it corresponded with the hight of the level. Measuring this showed the level to be 4 feet above the point *B*, and as it was 1 foot above the foundation, therefore the foundation was 3 feet higher than *B*. We then set up the level at *C* and went through the same operation to get the hight of *B* above *D*. To reach up far enough at *D* we used a full length of ¼-inch pipe slipped into a 5-foot piece of 1¼-inch pipe and worked it in and out like a telescope until the top was in line with the level, then laying it down and measuring it showed that B was 19 feet above *D*. Placing the level at *E* and doing as before showed that *D* was 11 feet above the water. Adding the different hights, 3, 19 and 11 feet, gave 33 feet as the total elevation of the pump above water, or higher than it would draw.

We reported the result and declined to go ahead with the work, but, as we might have expected in such a case, our figures were not accepted and the usual country surveyor was called in. The difference between our measurements wasn't a circumstance to the difference between his bill and mine, but the result was the same. The pump was not connected up.

C. F. SCHAEFFER.



FINDING THE ELEVATION OF A PUMP ABOVE ITS SUPPLY.

What Kind of Steel?

Editor American Machinist:

Many times I have asked that question of a man starting to make a die. The answer has generally been: "I dunno; just picked it up over there," or "I got it out of the stockroom." Now, if you were going to make a cutter, reamer or any other tool, for hard service, would you take such a chance? I doubt it. In no branch of the toolmaker's art is so little attention paid to the importance of selecting the proper stock for the job in hand as in die making. The order goes into the shop for tool steel, the foreman orders tool steel, the workman gets tool steel, the blacksmith is informed that it's tool steel and is told to harden it. If the blacksmith's heat happens to fit the steel, all is

well. If the steel and the heat do not happen to fit, then there is another story. But there is no use telling it here; we have all heard it.

The steel makers have progressed, but we have failed to keep up with the procession. There was a time when we swore by the name of Jessop; now some of us swear at it. Mr. Jessop was foxy enough to give us a steel that was pretty good for everything, and not exceptionally good for anything. We could not hurt it much with any kind of treatment. Nowadays the steel maker tries to give us just what we need. Sometimes he gets condemnation rather than praise for his efforts.

In most instances for small punches for heavy duty, you will see Stubb's, or the next best drill rod obtainable, used. Now, anyone who will think it over the eleventh part of a minute knows it's the poorest thing that can be used for such a job. Every toolmaker knows that fine, high-carbon steel crystallizes rapidly under concussion. For small punches at high speed in heavy stock, the lowest grade of steel that will harden under a white heat, will stand up fifty times as long as the best drill rod. This is no theorist's dope, but the result of unpleasantly intimate contact with the real thing.

I do not want to convey the idea that it is always desirable to use low-grade steel for dies and punches; I only want to urge the necessity of selecting the *proper* stock for the conditions. For light work or slow speed there is no danger of your getting too fine a grade of steel.

For shaving and drawing dies there is no question about the superiority of a fine grade of steel. Plenty of us have seen a fine, high-carbon steel, that should never be heated above cherry red, welded up to make a die. Then somebody wonders why the edges crumble and the die fails to stand up.

I notice that few people stop to consider that the stroke of the press cuts a figure in the matter of speed. We are inclined also to get into ruts in the matter of hardening. Sometimes the best results are obtained with a soft punch and a hard die; sometimes punch and die both hard are best, and then sometimes a hard punch and a soft die get the result.

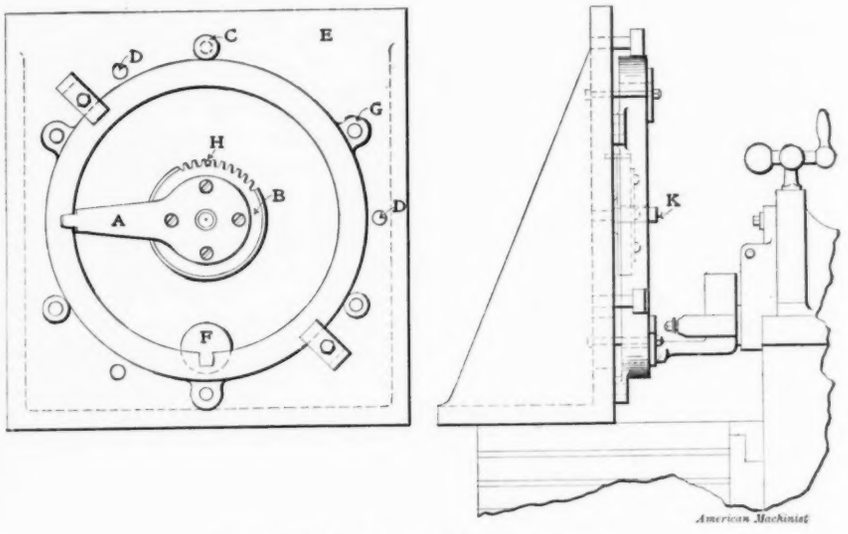
Not long ago I saw a die that cost over $5,000. It makes 216 formed pieces at one stroke. In a tool costing as much as that, careful consideration of what is best suited to stand up under the conditions is surely worth while. As our friend Miller said, in regard to this die: "Now, I suppose they will give it to some slob to set up and run." W. A. WARMAN.

Cutting an Internal Gear on a Shaper.

Editor American Machinist:

We had an internal gear to cut, 60 teeth and 5 diametral pitch. To do this with nothing better than a shaper at first seemed quite a puzzle. We will see how well it was done. No doubt it was not theoretically correct when finished, but as it pleased the party for whom it was done we must be satisfied.

Of course, the first thing to do was to chuck the casting and to bore and face it, at the same time taking a light cut over the outside edge as far as the lugs *G* would permit. The object of this latter operation was to have a true circle for a guide. After completing the above lathe work the angle plate *E* was drilled, locating the gear blank so as to use the large hole *F* for the end of the tool to run through, *i. e.*, drilling the six holes *D* as shown and fitting three studs *C* so as to use three studs at a time, and when the rotation of the gear brought the lugs *G* in the vicinity of the holes *D* of one set the studs were removed and used in the other set of holes. The heads of the studs being larger than the bodies gave a free



CUTTING AN INTERNAL GEAR ON A SHAPER.

yet true fit around the outside finished part of the gear blank.

Taking an ordinary lathe screw-cutting gear *B* with 60 teeth, after cutting the first space in the blank, arm *A*, a piece of wrought iron ¼ inch thick and cut out so as to fit over stud *K*, was secured to the gear, the end of the arm also being fitted to the space just cut. Leaving everything firm as when the space was cut, the hole for pin *H* was drilled and the pin fitted so as to allow no side play between the teeth.

Loosening the clamping straps and lifting the gear *B* on the stud K high enough to clear the pin *H*, the blank was turned around to the position shown in the figure. Now, as the arm is out of the way, we can cut all the spaces included in a quarter-turn of the blank. As before by shifting the arm *A* back to a position 90 per cent. or more, so that it did not interfere with the tool, all the remaining spaces were cut. When the spaces had all been cut we rolled the pinion around on the teeth, and by filing the sharp points a little a very good running job was the result.

J. N. GERMAIN.

The Minister's Sermons and a Good Machine Shop Story.

Editor American Machinist:

Our minister is a wise man and preaches about half the time well-written, scholarly sermons and the balance of the time more informal, off-hand discourses. But even so he does not succeed in pleasing everybody. For the other Sunday as I was coming out of church after one of the unwritten sermons, I met one of our members, who is a well-educated gentleman, and he remarked to me: "I think Mr. B—— makes a great mistake in preaching so much without notes. Of course it is easier for him, but there is so much more in those written sermons," etc. Before I reached home I fell in with another member, who is a hard-working farmer, and he said to me: "That sermon to-day did me lots of good. I wish Mr. B—— would preach that way more. It seems just like talking, and I can take it up so much easier," etc.

Now, I imagine that the editor of the "American Machinist" has a similar two classes to feed just as much as the dominie, and is often puzzled to tell how much space to give to articles of interest mainly to the managers of the business and the men in the office and drawing room; and how much to other articles adapted mostly to the men inside the greasy overalls and jumpers. The latter probably includes the larger class, and I sometimes think the editors are "shooting over the heads" of a majority of their audience. But then I fear that the men who do the hand work are not as ready to be helped as those who do mostly head work. And I know it would do these same machinists and operatives lots of good if they would read these higher class of articles and

endeavor to get interested in them and so keep on learning and rising and fitting themselves for better positions than they now occupy. The following story is not new, but it is to the point, and I have never seen it in print:

There was once an old gentleman who was running a small machine shop. A young man applied for the position of apprentice. He was given some encouragement, and they were talking over the matter when the young man asked, "How long do you think it will take me to learn the trade?" To which the old man replied, "That depends on how smart you are." This pleased the young man who had a very good opinion of himself, and the old man went on to say: "If you are a common, ordinary sort of a chap it will take you about two years to learn it. If you are bright and active and put your mind on your work, it will take you three or four years. But if you are right smart," he continued, looking the young man squarely in the eye, "it will take you *all your life to learn it.*"

Someone has said that we go to school in early years simply to *learn how to learn* and I think it is, or ought to be, much the same with the few years that are spent in "learning a trade," as we call it. I will venture to say that the editor of this paper has learned more in the past ten years than in any other ten years of his life. And Mr. Reynolds, a sketch of whose life appears on page 1377, is another one who has evidently not yet finished his apprenticeship.

I think it was Daniel Webster who said to an inquirer who thought the legal profession a little overcrowded, "Young man, there is plenty of room at the top." It is exactly so in our profession, and the "American Machinist" is doing a noble work in leading us onward and upward, and is to be congratulated that, while it is thus helping others to rise, it is itself so steadily advancing and developing.

Hackettstown, N. J. J. C. GREEN.

Inserted Tooth Counterbores.

Editor American Machinist:

Anyone who has made counterbores of solid tool steel and who after doing a few hundred pieces of work has seen them go into the scrap because of some defect in the steel, or perhaps improper tempering, will appreciate these suggestions for inserted tooth counterbores.

Fig. 1 shows a good form of counterbore for small, light work. The blades

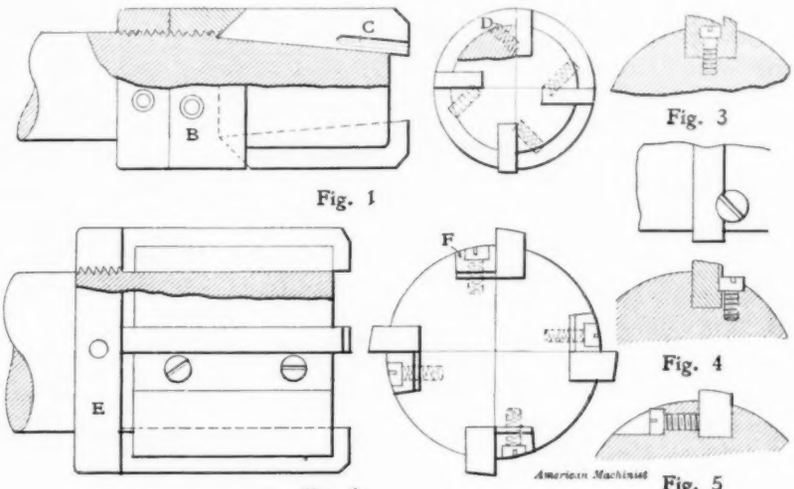


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

INSERTED TOOTH COUNTERBORES.

are set in a taper slot and forced down to the bottom and back of the slot by the points of set-screws *D* bearing in the grooves *C*. The other end of blade is held by the taper in the adjusting ring B.

Fig. 2 is better adapted for larger counterbore and heavier work. The blades are set into slots tapering toward the shank, and are held in place by the taper wedges *F*, which are nearly the same length as the blades. *E* is the adjusting ring.

Fig. 3 shows a method of inserting teeth in loose reamers of large diameter. As will be seen, the construction gives two cutting edges for each blade.

Figs. 4 and 5 show two other methods of inserting teeth in counterbores. While this may be a cheaper construction it is not so substantial or satisfactory as the method shown in Fig. 2. Adjustment is obtained by inserting liners under the blades when they have become worn and require regrinding to size. S. B.

Making a Cone-Pulley Pattern and the Molding.

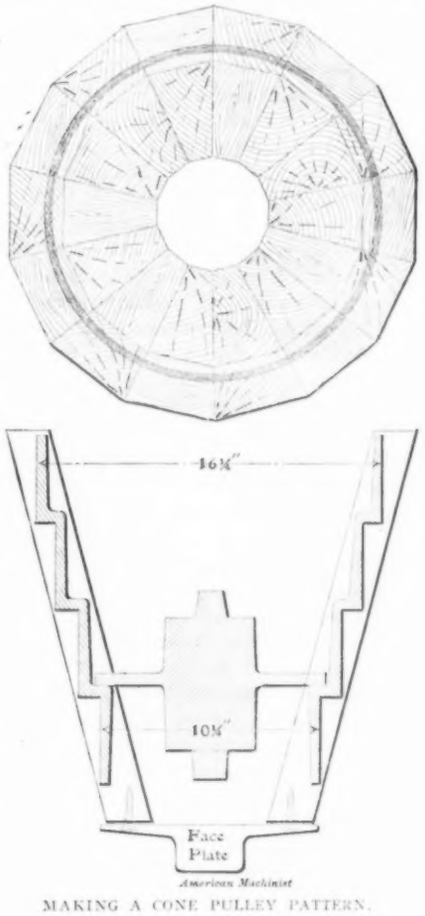
Editor American Machinist:

I send you a sketch showing a way I recently made a cone-pulley pattern. This pattern would usually be built up in segments with innumerable joints. I regard this way as superior, for the reason that the joints are in line with the direction in which the pattern is drawn, instead of crossing it as a built-up segment pattern would have them. I intended to put some hoops on it like a pail, but time did not permit. It has seen service without them and is still in good condition. By putting the face-plate on the small end and leaving extra length on that end to be cut off, I was enabled to turn the entire pattern without rechucking it. The web and hubs were turned separately and left loose in the pattern. Two holes (not shown) bored through the web enabled two $\frac{3}{8}$-inch bolts to be run down through the cope and thus to lift out the sand inside the pattern by the web under it. I think this a time saver in both the pattern shop and the foundry. J. L. GARD.

Unfit Apprentices.

Editor American Machinist:

Now that a few articles have been written about apprentices and the faults of those whose duty it is to teach them, I am going to advance a little argument for the side of the foreman who is blessed (?) with the presence of a few of these in his department. I have seen many of them—good, bad and indifferent—and I believe that the large majority of boys who are from their own, their parents' or their older brother's choice cast into the machine shop as apprentices are no more fit for the business than iron is for making brass castings. One might almost as well go to experimenting with rotary engines or perpetual motion as to waste time and energy on this kind. One of this kind worked in machine shops for three years, one year as an apprentice, and to-day he does not know how many thirtyseconds there are to an inch. I suppose this may



MAKING A CONE PULLEY PATTERN.

be laid at the door of those whose duty it was to teach him, but my version of such a case is that if a young man has not brains enough to learn the simple and familiar things of the shop without their being forced into him with a hydraulic press he is not fit for the business. He may perhaps be taught the running of some machine which has been set up by a mechanic and can be operated by a sort of automaton, and he may be to that extent useful in the shop; but even there a little common sense is not at all out of place, and, besides, the attainment of this is not or should not be the apprentice's goal.

The idea of putting boys in on three months' trial before commencing their apprenticeship seems to be a good one, especially if this trial time be preceded by a quite thorough examination of the applicant by one experienced in judging of the qualities which would fit or unfit a boy for the trade. The result of such an examination would be that nearly all of those who otherwise would have helped for three months to wear out the foreman, only to be given up at the expiration of that time, would never enter the works at all, and the small amount of time taken by the examination would be more than regained by this alone.

Reading, writing and a fair knowledge of arithmetic would seem to be absolutely necessary for full ability to learn the trade, although only a limited knowledge of these (through circumstances beyond the boy's control) may be offset by a willingness and ability to learn, in which case the lad may be more fit than some other one farther advanced in school education.

It may be said that there are able machinists who cannot read or write and who know little of figures; and certainly there are such, though it must be admitted that they have attained to that degree of ability entirely in spite of this ignorance, and that, through being deprived of the benefit to be received from the excellent mechanical literature published, they cannot know of and profit by the experiences of many others and their efficiency cannot but be thereby retarded. It also is impossible for such to ever advance beyond the actual shopwork, and when they are questioned on subjects involving mechanical principles they are always found wanting in some points a knowledge of which would materially add to their all-around ability.

It was one of these men who once told me that circular saws "always become thicker near the center after running a while, as the metal is drawn toward the hole." It usually has been men of the same class who, in their earlier practice, have attempted to set a lathe for turning taper by prying the tail end around, or who have followed the advice of the practical joker and tried to sharpen a dulled file on an emery wheel. The latter I have seen done myself, and I am now ready to believe almost any story of that kind.

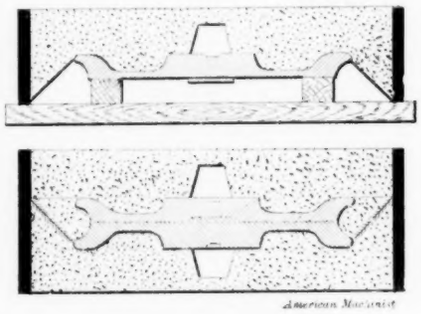
Whether it would have been better if such men had followed some other vocation I would not dare to say. In almost every business or trade common sense and education are very helpful, if not essential, It may not be unreasonable to say that there are many men in various vocations who are badly misplaced, and that if some of these had been satisfied with employment equal to their capacity it might have been to the benefit of others who are barred from vocations for which they possess the ability. It is likely that those who think that the failure of apprentices is due to the foremen in charge have had experiences that have seemed to justify this belief, and undoubtedly this may now and then be the case; but, as sure as cream will rise to the top, a boy with brains with a liking for the trade and anxious to learn outside as well as during working hours will advance in spite of anything. This last particular, that of not confining the time of learning to working hours, is the most important of all, as it proves the existence of interest in as well as ability for the business.

CORNEIL RIDDERHOFF.

Molding a Rope Sheave.

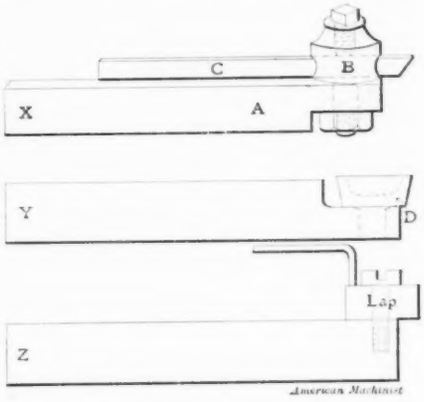
Editor American Machinist:

Here is one way of molding a rope sheave in a two part flask; the upper figure shows the first step. One half of the pattern is blocked upon the "follow board" to a hight equal to the thickness of the other half, the flask resting on the board in the usual way; but, as this part will eventually be the cope, provision must be made for pouring. After ramming up, roll over, remove the follow board and make a bevel parting from the outside of the flask to the largest diameter of the wheel. The best way, if more than one or two were to be made, would be to have a



MOLDING ROPE SHEAVES.

"match" to drop the half pattern into, with the outer edge shaped for the parting. This being fastened to the follow board would come away with it and leave but little patching for the molder to do on the joint. After setting the other half of the pattern in place, and before putting on the second flask, the first one is filled, rammed up and a straight joint (parting) is made, taking care to leave the ring of sand around the hub in condition to unite with that of the flask now to be placed and rammed up. To withdraw the pattern from the mold, lift the last-named flask and draw one-half of the pattern. I should prefer to have both core prints loose and to come away with the flasks. Put back the half flask, roll over and lift the other half, which is the first one used for the mold. The mold will now part at the bevel joint, gravity alone causing it to part there freely. Next remove the remaining



TOOLS FOR SHAPING CIRCULAR FORMING TOOLS.

parts of the pattern. Set the core for the hub. Clamp the mold, and it is ready to pour.

I thought it not necessary to show the guide lugs and pins on the flask, as they will be understood. It is very likely that some of your readers who are practical molders will be able to send you a method of doing this work better than here described. I know they do not like the three-part flask business; therefore I sometimes make the pattern solid, with a core print projecting beyond the circumference of the wheel proper and making a circular core box, the cross section of which conforms to one half of the groove and core print combined. This can be turned out on a flat plate to place in the core oven. This plan pleases the molders that I am in touch with, but others may prefer another way.

WM. NEWTON.

Oneonta, N. Y.

Tools for Shaping Circular Forming Tools.

Editor American Machinist:

In turning circular forming tools for balls, worm-gear blanks and large or small fillets I find the following tools very handy: *X* is an adjustable tool. *A* is a piece of ½x1-inch tool steel with a 5-16 inch hole drilled and reamed and a clearance cut away for the nut. *B* is a stud turned .750 inch at the largest part, so that the tool can be set by scale from the outside edge and turned to fit the hole in *A* and threaded for nut, also tapped for a 5-16 inch screw. This stud turns freely with the nut tightened. A 5-16 inch hole is drilled through the large part of the stud so that the small tool *C* will clear the top of *A*.

C is a piece of 5-16 inch round steel flattened on the top.

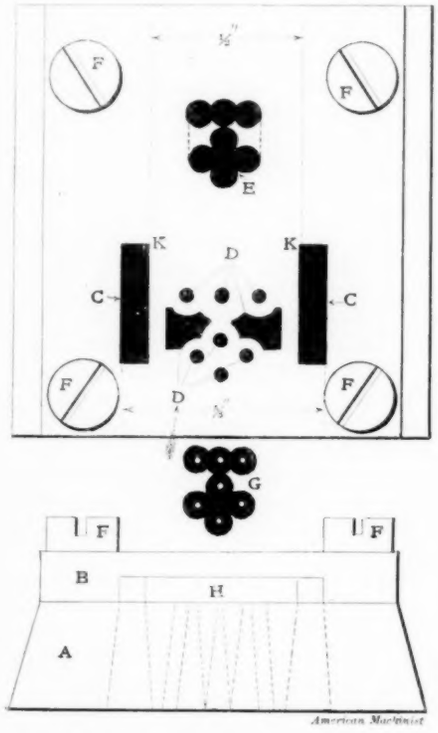
Y is used for smaller work, the cutting tool *D* is driven into the holder and should be turned a little taper to give clearance in cutting.

Z can be made by tapping a ¼-inch hole in the other end of *X*, and is used for lapping circular forming tools. A very fine finish can be given to the tool in this manner. H. L. G.

Fine Power-Feed Punching Without Sub-Press.

Editor American Machinist:

I have been much interested in the die work described in your columns by Messrs. Doran, Woodworth, Wilder, Dougherty and others. I once designed some tube machines to draw closed tubes, unsoldered, through a die plate, and they were good machines. I would like to show your readers now a method I have



DIE FOR FINE PUNCHING AND BLANKING WITHOUT SUB-PRESS.

used for very fine power feed piercing when it would not pay to use a sub-press die.

In this die, or cutter, as it is commonly called, *A* is the die blank; *B*, stripper; *C*, trimming die; *D*, piercing die, and *E* the blanking cutter die, *F* being the screws to hold the stripper on *A* and *G* the piece produced, the latter shown actual size, while the die is enlarged. The holes in the finished piece are .054 inch diameter, and the radii of the circumscribing circles are all 3-32 inch.

Now, the operation is that the stock shall enter at *H*, and, passing to the reduced part of the stripper at the inner end of *C*, shall be trimmed on the edges to pass the reduced part mentioned. I think it is perfectly plain that when the rear part of the trimmed stock has advanced to the shoulders in the stripper it can advance no farther, and if the roll feed has been adjusted to carry it, say, 1-16 inch longer than the trim, the stock will be held rigidly in position, both on the sides on account of the trimming and at the end for the same reason, thus advancing the piercing to an exact location in regard to the blanking cutter.

This die is simple to make and I have used similar ones a great deal for light embossing where it was essential that the die should trim very close to the engraved work and leave no "fin," using the embossing in place of the piercing and doing the piercing as a second operation between the blank and the embossing dies, it being understood that the piercing punches must be "entered" before the embossing force shall draw the metal out of shape.

I would be pleased to show some samples of work done this way, on request, and out of an infinite number of pieces I have yet to see any variation whatever. In case of repair and in every other way, except in quickness of setting, I regard these tools as far superior to any combination die made, for cheapness and accuracy.

CUTTER MAKER.

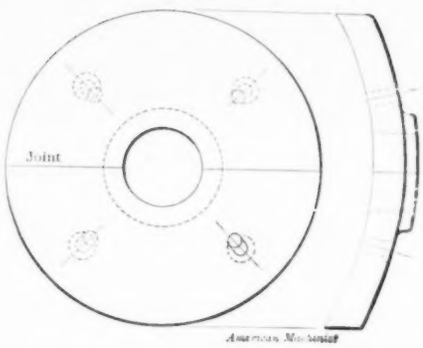


FIG. 1. CURVED FLANGE TO BE TURNED.

Facing Curved Flanges.

Editor American Machinist:

Some time ago I was employed in a shop where a large pumping engine was being built, and among the many pieces that went to make up said pump were a number of curved flanges like Fig. 1. These flanges were cast in two pieces and were used as finish over the black-walnut lagging on a number of small steam pipes that branched off the main and auxiliary steam pipes at right angles. Although of various diameters and bores the thickness of all the flanges was to be the same, viz., ⅝ inch.

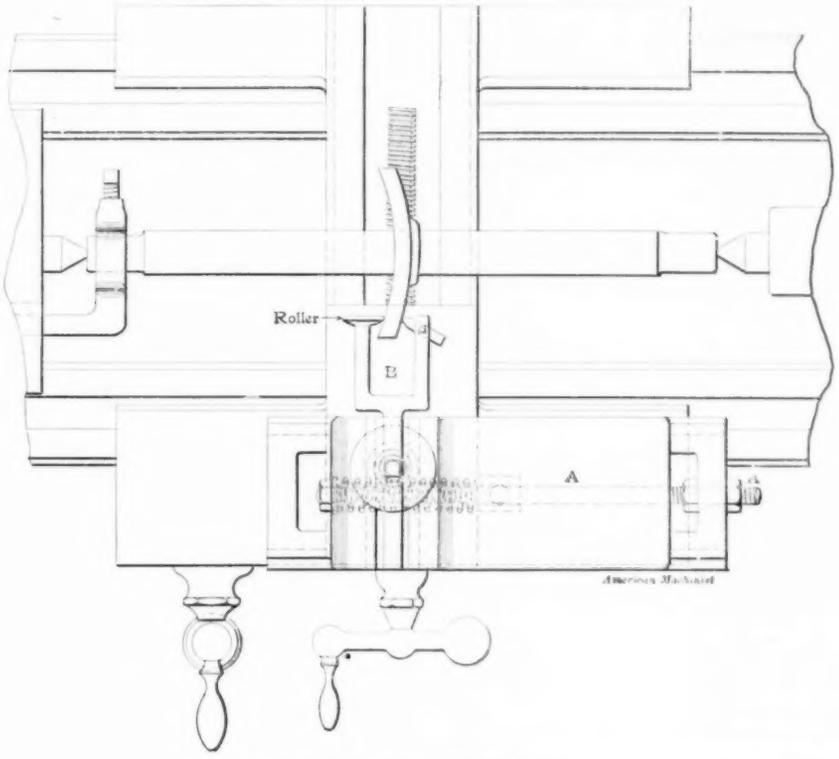


FIG. 2. FACING A CURVED FLANGE.

It was the original intention to bore and turn the flanges on the edges and to grind and polish the convex side, but, owing to an oversight on the part of someone, the flanges were cast ¾ inch thick, and were milled where the halves joined, before the mistake was discovered. After a short consultation they were given over to me to turn them down to ⅝ inch.

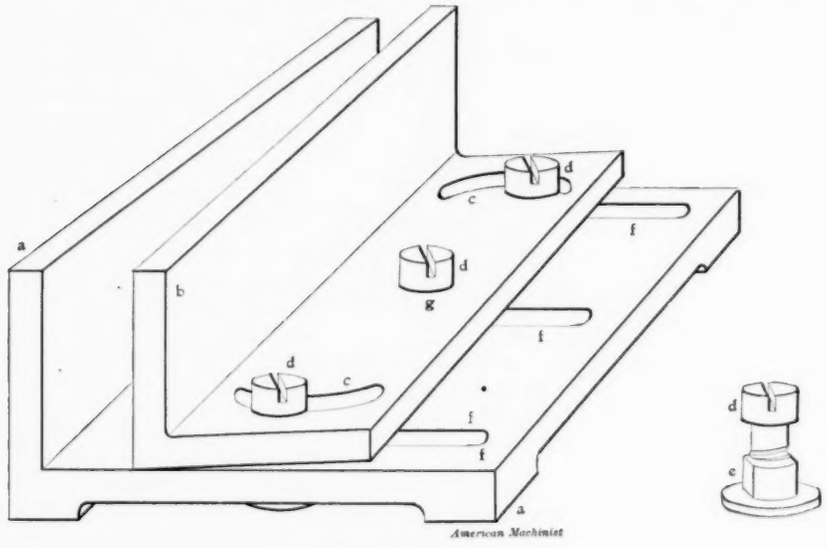
The first step was to match them up and soft solder them together. They were next chucked very carefully and bored to the required dimensions. The next operation was to smooth them up (with the

file) on the concave side—that is to say, the scale was not removed, but simply the lumps and inequalities were smoothed down. They were now put on an arbor successively and turned on the edges to the proper diameter. This done, the compound rest of the lathe was swung around parallel to the ways and the screw was removed. The slide was thoroughly cleaned and oiled, and the gib was adjusted, so that the slide would move easily. The stud *A* was now put in the screw hole with the spring pressing against the nut of the slide, forcing it in the direction of tailstock.

The forked toolholder *B* was now put in the tool post with the roller in contact with concave side of the flange, the carriage was put into a position to slightly compress spring and clamped.

Now, it is very evident that as the flange turned the roller followed the back and forth motion of the flange and the tool of course did likewise, so that the flanges were turned on the convex side just as easily as though they were straight. When the shoulder was reached the tool was drawn back ¼ inch and that part of the flange finished.

I do not claim that faces thus finished were as smooth as one could finish a flat surface, but after a little polishing and buffing they looked very presentable and filled the conditions for which they were intended. As we had about thirty of these to get out, we considered it cheaper to spend a couple of dollars for the tools here shown than to alter the patterns and recast all the flanges. WABBLER.



A TAPER GAGE FOR THE TOOLROOM.

A Taper Gage.

Editor American Machinist:

While browsing in a toolroom I came across an arrangement like the accompanying sketch. I had to inquire what it was, whereas a more expert mechanic would have recognized it at once as an adjustable taper gage. It consists of two cast-iron angle pieces *a* and *b*, the former having three straight slots *f*, thus allowing *b* to be adjustable for width, while *b* has two slots *c* curved around *g* as a center, thus allowing *b* to be set on any required angle. To clamp the two members together the machine screws *d* are tapped into the nuts *e* which play in the slots *f*, the nuts being flattened on two sides so as to pass easily without turning around. A large flat head on the nuts prevents their pulling through, while the feet at each corner of *a* are made a little thicker than these flat heads. The article to be gaged, lathe center, tap or reamer, is placed between the uprights *a* and *b*, which are then closed up against it and fastened by the screws *d*. Thus the angle may be retained so that other tools may be made to match.

W. H. SARGENT.

Characteristics of Boys and Men.

Editor American Machinist:

Some time ago we were in need of a boy or young man who could make himself generally useful around the drafting room, make blueprints, etc., and, above all, who would develop into a good tracer and detail man. Since then we have found by experience that such a one is hard to find. We tried several, but there soon developed in each some serious fault which proved him unsuitable for the place.

No. 1 was a high-school graduate; he could make a fine-looking tracing, his lettering being far above the average. He was dressed to the top of the fashion, and I am sorry to say was afraid of both dirt and work. I hardly ever came into the room suddenly but that I found him loafing. While I am always perfectly willing to stop and show a man anything he doesn't understand, I do detest having him always waiting for a job; I prefer to give him enough to last for some time, but just as sure as I gave this one several jobs at once he would do the first one and then wait until I asked him what he wanted, when he would say he was "out of a job."

No. 2 was a grammar-school graduate and exactly the opposite of No. 1 in both dress and manner of execution. If I sent him into the shop on an errand, he generally forgot what he wanted and would never think of washing between handling dirty patterns and going back to his tracing. His inking was something awful, and I never was able to give him anything but the most simple work, to do which he would take from six to ten times as long as he ought, the main part of the time being spent in dreaming over it.

I felt sorry for him because he did try and needed the work. However, we were convinced that he never would make a draftsman and finally succeeded in finding him a position which we thought better suited to his abilities.

Following these two we had five, of which these were fair samples:

No. 6 was a high-school graduate and had nearly completed the course in mechanical engineering in a correspondence school. He was recommended to us as being the best mathematician in his class and came with the idea that he was a competent draftsman capable of doing anything in the line of drafting.

The first day I sent one of the detail men out to show him about blueprinting, when he took the opportunity to criticise the execution of the tracings. Upon hearing of this, I thought we must surely have an expert. Anyone can imagine my surprise after giving him some tracing to do to find that it was hardly readable and the mistakes he made were innumerable. I asked him to figure the approximate weight of a lot of castings from the drawings. Hardly one in five were as near as I could guess. For instance, one piece which was ½ x 2 x 15 inches he said would weight 1¼ pounds (and he the best mathematician in his class!).

After he had been with us about two weeks I had occasion to send him to the foundry. He didn't know where the foundry was. I was very much relieved when he came to me one day and said that he had decided to give up his job and go to college, which I thought would be very much like pouring water into a sieve.

No. 7 is willing to do anything I ask him, can make a neat tracing and do it quickly, the only trouble being that he is always afraid he will spend too much time on a job, and consequently makes mistakes, but by continually hammering at him he is outgrowing it and I think we shall eventually get something out of him.

I have seen a good many correspondence school graduates, each of whom thinks he is a little above the average.

I feel that it is a great mistake to lead anyone into thinking thus, for it only makes him dissatisfied when he finds that he has to begin at the bottom and rise

slowly. It is also a mistake for a man to learn to be a draftsman without a reasonable foundation to begin on. Unless he has more than average ability he can never be anything but an ordinary draftsman, and I doubt very much if he can do as well as he would at the machinist's trade. The ordinary draftsman is not necessarily a designer any more than an ordinary machinist is an inventor. The only advantage a draftsman has over a machinist is the greater opportunity of showing his ability, and this will do him but little good without the ability. I do not dispute the value of the correspondence schools; they are a good thing, and I have advised many men to take their course.

A course in drawing is an excellent thing for any machinist. He will never regret the time spent. Even if he doesn't have a chance to use the knowledge acquired directly, indirectly it will be of great help to him. Any systematic study will help to develop a man's mind and make him better fitted for whatever he has to do, but I would not advise him for a minute to give up his job in the shop for one in the drafting room unless he can see some extra good opportunity.

I know of two men in the shop who began about the same time, fourteen years ago. The first has never shown himself able to do anything new without a great deal of explanation, and consequently is doing the same to-day that he began with. I imagine he is always thinking of something else besides his work. The second was always able to take up a new piece of work and do it to advantage, and he now holds the best position in the shop—that of inspector.

In the drafting room the first would still have been tracing, the second might have been chief draftsman, superintendent or manager, but how much better off would he have been than he is to-day?

A certain foreman in the shop is always fooling with his men; of course, the men like him, but what would his employer think of him if he knew it? Right beside him was another foreman who took hold and worked, as well as seeing that his men worked. A few weeks ago there was a chance of promotion. It is needless to say who received it.

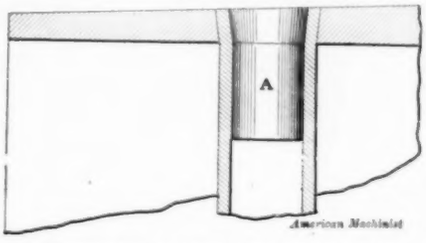
The main thing that makes a man valuable is putting his entire energy into his work and doing everything the very best that he can. The man that is working for "sundown and wages" is worth but little compared with the man who endeavors to earn all that he is getting and a little more, and it is seldom that a man gets "a raise" until he earns it.

I have known of men who asked for more money and who, upon being confronted with the statement that they didn't work as well as they might, would reply that they could earn more if we would only give it to them. X.

Fastening Pulley Arms in their Rims.

Editor American Machinist:

Our foreman, P. Sluys, has devised the method shown in the accompanying sketch for fixing the arms of our iron pulleys in their rims. As you may see from the



FASTENING A PULLEY ARM TO THE RIM.

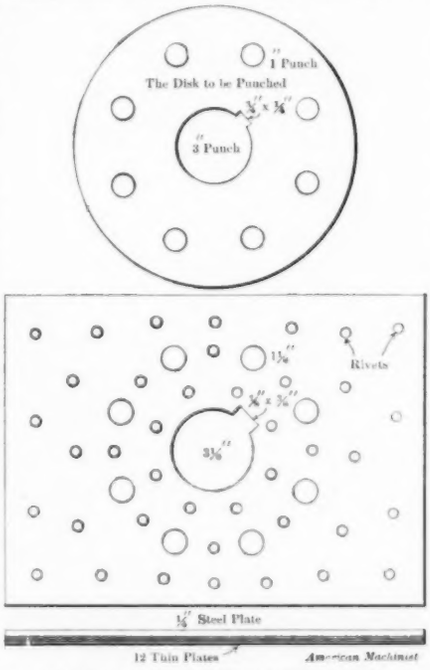
sketch, our pulley arms are made of iron pipes. To fix the pipe in the rim, Mr. Sluys sinks the plug *A* with a hammer. This fastening is very secure, as shown by our experience. ARTHUR BOLLINCKX.

Brussels, Belgium.

A Cheap and Perfect Stripper for Thin Sheet Metal.

Editor American Machinist:

I have found it quite an expensive job to make a good stripper for thin sheet metal disks, say No. 26 gage, using for the stripper ¼-inch iron or steel plate. By the method that I have now adopted the disks come out of the blanking press perfectly flat, instead of having the edges of



A STRIPPER FOR PUNCHING THIN DISKS.

the metal drawn up through an imperfect stripper.

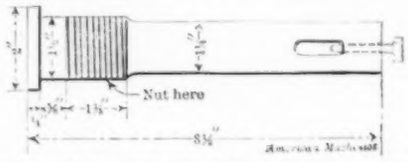
I first drilled the holes in the ¼-inch plate ⅛ inch larger in diameter than the sizes of the various punches, this being a comparatively easy matter, as a slight variation would do no harm. I then punched a dozen plates of the thin metal and hammered them flat, and then by matching them evenly, fastening them in position by rivets and then simply easing them out a little with a file and finally fastening them to the ¼-inch stripper plate, I had a perfect stripper, with but little expense. The sketches will tell the story. H. R. ASH.

Chicago.

A Tool Holder for Internal Work on the Shaper

Editor American Machinist:

The sketch shows how we do internal work on the shaper. We do not go to the expense of making an extra apron. We simply remove the regular tool-post and put this device in its place, screw up the nut, chuck the work and go ahead. We find it very convenient for keyseating small



TOOL HOLDER FOR INTERNAL WORK ON THE SHAPER.

gears. This is not new, but may be interesting to some who have not seen it.

Reading, Pa. B. A. ROBERTS.

Hard Soldering.

Editor American Machinist:

Hard soldering is an operation looked upon by many mechanics as one to be avoided whenever possible, the idea seeming to be that it is more or less of a chance process, with odds against the workman.

If the action of heat and the nature of the metals in hand are understood there should be no trouble in obtaining a good sound joint, provided the proper facilities are available. Jewelers, as a rule, are very painstaking in their preparatory work, rubbing borax paste upon slate, exercising great care to avoid touching the joint with the hands, so as to have chemically clean metallic surfaces, etc. This is all correct, theoretically, but some machinist workmen also pay all attention to these details, and yet lose sight of the more important fundamental principles, especially those pertaining to temperature. In a large proportion of the hard soldering to be done in the average shop, the observance of these minor details first referred to would involve considerable trouble. These may be safely ignored to a large extent if the applications of flux, solder and temperature are properly made.

To begin: Have the joint as tight as possible, to prevent the solder from running through without filling. Apply the flux paste before any heating is done, and do not put the solder on until the work is at about a low red heat, depending on the character of the work, metal, shape, etc. Apply the heat to the joint rather than to the solder, and if the solder runs immediately as it is fused, have no fears

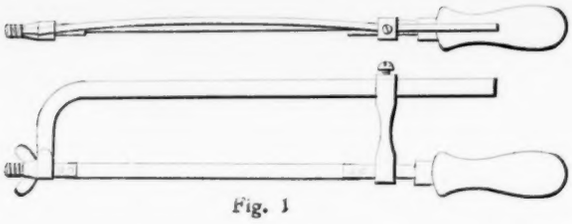


Fig. 1

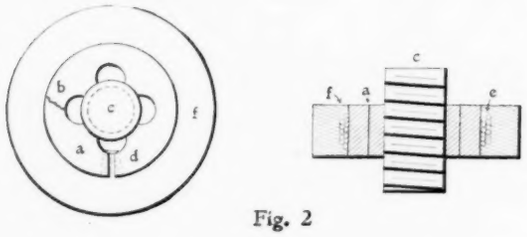


Fig. 2

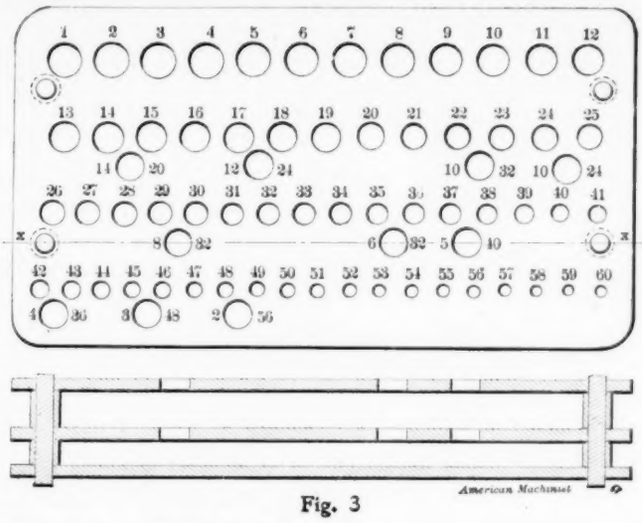


Fig. 3

A SPRING HACKSAW FRAME—REPAIRING A BROKEN DIE—STAND FOR DRILLS AND TAPS.

as to the success of the job. In cases where a joint cannot be drawn tight, fill up with wire, scrap metal, filings, etc., of the same metal as the work. This may also be applied to the outside of the joint if it is desired to retain solder for reinforcement.

If these rules are adhered to, it will be unnecessary to mix your flux paste on slate, and slight fingering will not prevent the making of a good joint. However, cleanliness is a trait to be cultivated, and is desirable in all soldering operations. If the joint is not reasonably clean, solder will not flow readily, more being required to dispel or vaporize the grease or other foreign matter. J. R. PRICE.

Philadelphia, Pa.

Hacksaw Frame—Repairing a Die—Stand for Drills and Taps.

Editor American Machinist:

Fig. 1 is a spring-back hacksaw frame; the spring gives a constant tension on the blade; it is made of $\frac{5}{8}$x$\frac{1}{8}$-inch spring steel hardened and blazed off; the blades seem to last longer and fewer teeth break out. The top view shows the flexure of the back when in use.

Fig. 2 is a screw die which broke at *b* before the job was finished. A finished screw *c* was put in and the die was adjusted by adjusting screw *d*. It was wound with iron-binding wire *e*, then placed in a hole bored in a block of wood and melted lead *f* was poured in. It was then turned off to fit a larger die stock, and it cut as well as ever.

Fig. 3 is a drill and tap stand. It is made of three pieces of sheet brass; the top piece is drilled for drills and also for taps, the second or middle piece is only drilled for drills and supports the taps, the third piece supports the drills. The holes for the taps and drills are drilled larger than their respective sizes, which prevents their sticking in the holes. The four legs are made of four pieces of wire and eight pieces of brass tubing which act as distance pieces. Between the rows of holes for the drills are holes drilled through the top sheet only for taps, the tap being placed under or in front of the drill to be used. S. V. S.

Emergency Arrangement for Circular Planing.

Editor American Machinist:

The casting, Fig. 1, was brought in one morning and we were asked to give a promise as to when the job would be completed. Upon examination we found that to machine the arc to the specifications would require a larger tool than we had in the shop. Our largest lathe would swing only 15 inches. We were hard pressed for work and did not like to see a job go out; so after a little we gave a promise, and Fig. 2 will show how we set about to machine the arc.

Lathes *A* and *B* when in their proper places faced in opposite directions, and the first thing to do was to turn lathe *A* around, bringing its face-plate in line with face-plate of lathe *B*. The tailstock of lathe *A* was shifted past the carriage, leaving the entire space between the face-plate and the tailstock clear for the swinging of the cutter bar *c*. This bar was made of 2-inch square iron and clamped to the square arbor *d* as shown. The arbor in turn was made fast to face-plate by means of dog *e* and clamp. The cutter bar *c* does not need any more defining, other than to say that it was made the right length to give a radius of 24 inches. The adjusting of the tool was accomplished by means of the screw *f*, of an ordinary planer.

Next, we made the piece fast to the carriage of lathe *b*, first removing the cross-feed and tool-post slide. By using parallels the work was raised to the proper hight. The studs *r* and *s* are located to give the proper movement to the cutter bar; *i. e.*, the face-plate of lathe *B* must rotate to move the carriage along, and keep the work against the tool. The tool, of course, can't turn, because the lathe *A* will not permit it to; hence, the distance from the lathe center to pin *s* is considerably larger than the distance from the other lathe center to pin *r*. These pins are connected by rod *i*, a flat piece of iron, 4x1½ inches.

The face-plate *N*, making complete rotations causes the tool, during the first half, to swing from point *n* to point *m* and during other half from *m* to *n*.

It required very little time to find the right radius for stud *r*, and we soon had the job well under way. We could not use very heavy cuts, but by using fine feed the work was successfully done.

J. N. GERMAIN.

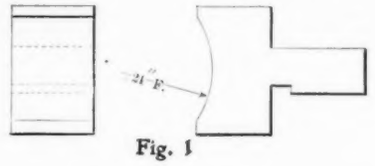


Fig. 1

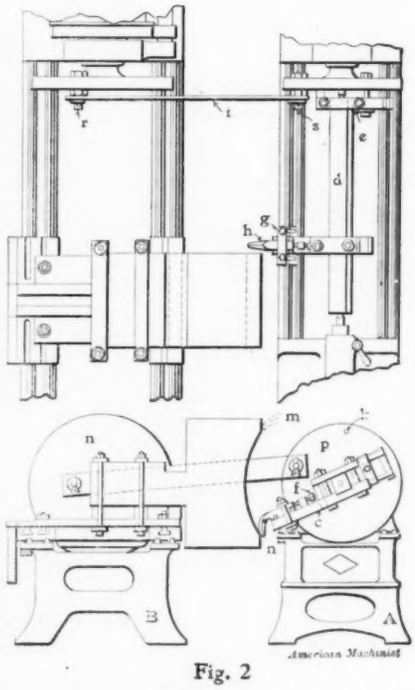


Fig. 2

A SPECIAL ARRANGEMENT FOR CIRCULAR PLANING.

Vise Block—Expanding Tap—Beam Dividers—Depth Gage—Tap Wrench.

Editor American Machinist:

The accompanying sketches will illustrate several simple tools which are very convenient and useful.

Fig. 1 shows a piece of steel milled in the shape shown, which is hardened and held in the vise and used as a riveting block. I find it to be very handy.

Fig. 2 represents a type of expansion tap which gives good satisfaction where used, which is mostly on brass, with fine pitches. *A* is the body of the tap, which has three slits, and *B* is a nut or stud into which the taper screw *C* screws to expand the tap. It is used in the screw machine and fits the hole in the holder with just a little shake, and also a little on the pin *D* which keeps the tap from turning, the holder being made to fit the hole in the turret.

Fig. 4 represents a pair of dividers with ball or pump centers or plain, whichever is desired. They are very handy for diemakers in transferring and laying out holes or work where the surface is not even. The points can be adjusted up or down as the case may require. The centers or points are tightened by the sleeve *R*, the holder being split with a fine saw, and slightly taper on the end, acting as a split chuck. *B* is a clamping washer clamping the upright to the horizontal bar *C* by tightening the nut *D*. It is also provided with an adjustment which allows it to be set very close.

Fig. 3 shows a style of transfer or depth gage which is neat and convenient, the rod being clamped in the V-slot in the end by the screw and nut as shown.

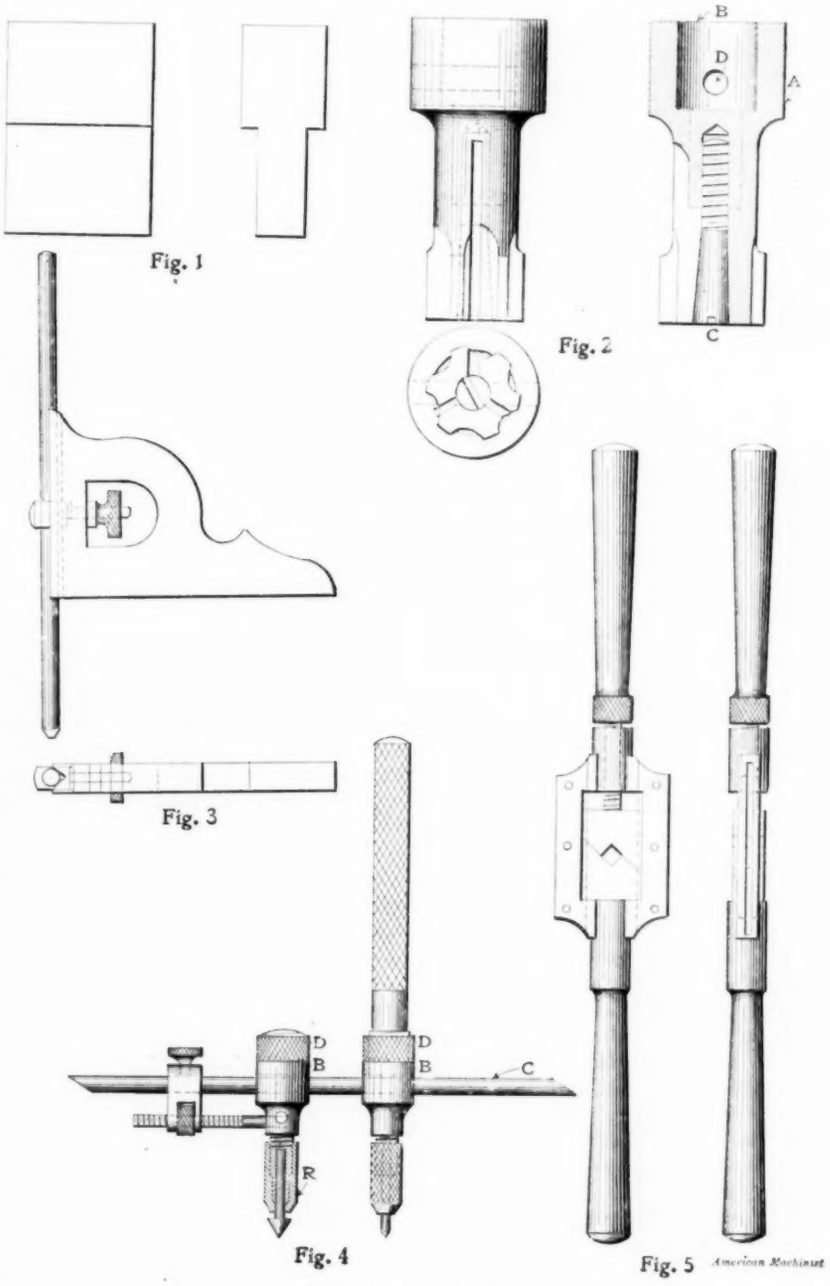


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 American Machinist

HANDY SMALL TOOLS.

Fig. 5 is a small tap wrench which I made some years ago. It does not differ much from the general style of wrench, only in the way the jaws are held in. The body of the wrench is sawed on its edge deep enough to come through about 1-32 inch into the slot, the jaws also being sawed out to fit on the piece which is fitted nicely into the slot made by the saw, which is held by the three small taper pins shown, the lower jaw being tight, while the upper one slides freely.

M. W. Leech.

The Development of an Old-Fashioned Shop.

Editor American Machinist:

Fig. 1, although crude, is a fair representation of a shop of thirty years ago, in which some boys as young as twelve took their first lessons in the trade. Fig. 2 shows the power used. Driving the horse was often the first lesson of the young apprentice. I was fortunate enough to have seen the erecting of the building and to have stayed until the business outgrew the shop and tools. The outfit at the beginning consisted of the power, Fig. 2, one small lathe, about 12 inches swing and 6 feet between centers. This lathe had wood shears, chain feed, cast-iron ways on which the carriage traveled, wood cone pulleys and cast back gears. The first work done on it in the new shop was to turn the ends of ¾-inch rods for a length of 3 inches. We were intending to build agricultural machinery, and, as a start, decided to build a one-horse tread mill to displace the sweep power, Fig. 2. Said tread-mill power required twenty-eight such rods. Of course, each apprentice was anxious to get a chance at the first lot, but later on he changed his mind. The variety of work on the lathe was not great: turning the rods and boring and turning the wheels which ran on them was about all there was to be done.

The wheels were 3½ inches diameter and about ⅝ inch face. We had no chuck and so we bolted a piece of hardwood to the face-plate and bored a hole in it to allow the wheel to be driven into it with a part of the rim projecting. Fig. 3 shows chuck and wheel. By turning the spindle and hammering the wheel it could be very readily trued up. The boring was done with a flat drill made from an old file and finished with a very crude reamer.

We also had a drill press, Fig. 4. Soon a small circular saw was added and then a larger lathe, which also had wood bed and no carriage at all. This lathe we used principally for chuck or face-plate work. Whatever turning or facing work we had on that lathe was done with an old-fashioned slide rest, Fig. 5. This rest the boss made himself—first the patterns and afterward all the machine work except the planing, which he did with hammer, chisel and file. The screw he cut with an old-fashioned screw plate.

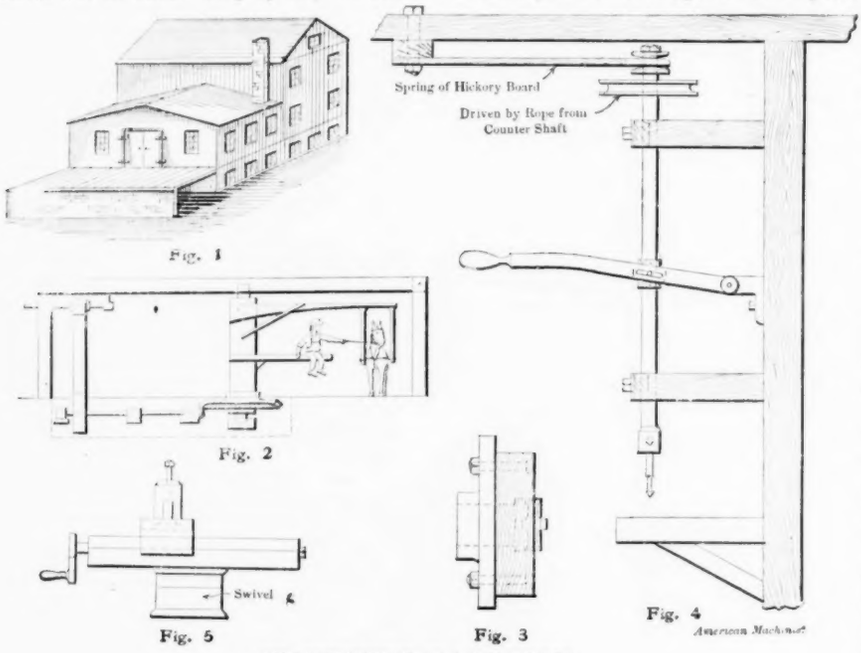
The plant outgrew the one-horse tread power and our business demanded other

tools, both for iron and wood work. Nothing less would do than a 4 horse-power steam engine. This was purchased of a prominent firm in Wilmington, Del., still in business there. My first lessons in steam engineering were in firing and running this machine.

The thorough knowledge of any trade consists in learning it in all its branches. No one twenty-five years ago was considered a competent machinist unless he could perform any and all operations required. The workmen were compelled to make and keep in order all the tools used. Our blacksmith shop was very small and poorly equipped, but in it we learned to forge and temper our tools and to make the great variety of forgings required in a country repair shop. The things learned in that little blacksmith shop have many times been useful in overcoming difficulties encountered when no regular blacksmith was at hand. Step by step we built up a business and collected a fair equipment of tools and appliances, learning as we went along, the various branches of the machinist trade, as well as pattern-making and wood working, as at that time required in the manufacture of agricultural implements. We did not, perhaps become fine workmen in all things, but we learned the foundation work thoroughly. After four years we added to our plant a small foundry, and this enabled the boys to learn to some extent the trade of molding and, incidentally, iron melting and mixing, so that at the age of twenty, they had had a very thorough training in the line of work done, although it was rough, and none of the refinements now necessary had been learned. They were capable of starting out for themselves, either as journeymen or as proprietors of similar establishments. In my opinion there are at the present time plenty of chances to start in the machinery business just as the proprietor of this shop did, he starting with less than $1,000, at the age of thirty-five, and gradually building up a concern which to-day employs nearly 200 men, and which is doing a good business in the line of power transmission and turbine water wheels.

Any smart young man, if he had the grit, could start as his own boss with no capital but his kit of tools, and not only make a living but in time a fair competence. He would have to be energetic and patient. Whatever he did would have to be done right. He would have to be capable of doing almost anything that could be called for, from the filing of a common wood saw to the rebuilding of a steam engine, automobile, bicycle or any of the machinery of the present day.

Why don't some of you young men try it? Don't locate in a city. Strike out in the country to some village as far as possible from the large towns. Start your little shop, even if not more than 10 feet square, and without power of any kind if you have no money to buy it. Do what you can, and if you are what you ought to be you will soon become indispensable in your neighborhood. The chances are far better now in this age of machinery than they were thirty years ago. But you must be a *mechanic*, and well posted on all classes of work. You may never become wealthy, but you will have the satisfaction of leading an independent life, and stand a good chance of accumulating all that is necessary for your needs. B. W. T.



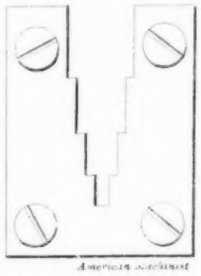
THE BEGINNINGS OF AN OLD SHOP.

Wrench for Lathe Dogs—Carbon Copies of Sketches.

Editor American Machinist:

The sketch explains a handy attachment which is quicker than a wrench for tightening or loosening lathe dogs. It is made of machine steel, case hardened, and is fastened to the right-hand side of the apron.

It seems to me that the practice of making carbon copies should be adopted by foremen who have to make sketches for



WRENCH FOR LATHE DOGS.

men to work to. This is done in the office and it would be just as advantageous in the shop, and would cause practically no more work or trouble while it would save a good deal of both. It is hardly necessary to state how desirable it is to have a copy, instantly accessible, of a sketch which may be going the round from blacksmith to machine or vise and which possibly will be rather the worse for wear by the time the job is done. D. E. F.

Turning Eccentric Piston Rings.

Editor American Machinist:

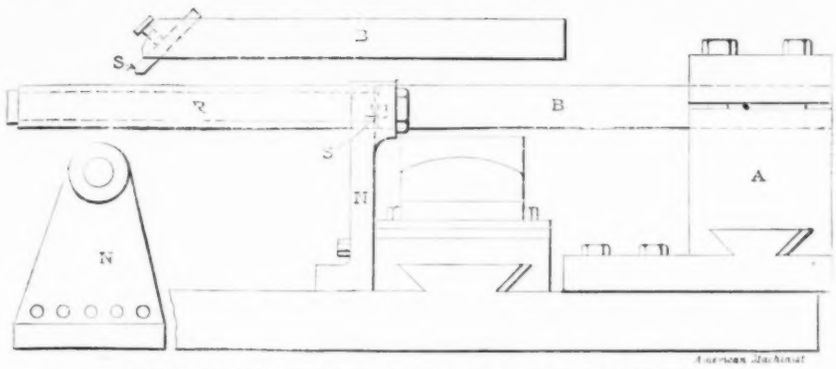
The following method of boring and turning eccentric piston rings at one setting resulted in a considerable saving of time: The casting, of the usual flanged type, was fastened to the face-plate by cap screws from the back, being chucked true by the bore. The boring tool *S* of special air-hardening steel was inserted in a 2-inch bar *B* carried by an auxiliary cross slide *A* bolted to the carriage on the side toward the tailstock. Alinement was of no importance. To turn the outside of the ring, the inside being bored true, it was necessary to impart a transverse reciprocating motion to the tool. To accomplish this, the lower cross-feed screw was removed, the compound rest being used for getting the depth of cut, and a long roll *R* mounted on a heavy stud securely attached to the cross-sliding block by the bracket *N* was brought into contact with the eccentrically turned edge of the face-plate. A heavy spring, not shown, between the cross-slide block and the back of the carriage maintained the contact.

For cutting off, a gang tool was used so stepped that the outer one was cut off first and then the others successively nearer the face-plate. A. B. C.

Tool-Post for Round Steel of Different Sizes.

Editor American Machinist:

The accompanying photographs illustrate a tool-post I devised for using round stock of different diameters for boring and sometimes also for turning. In turning square threads it is especially convenient, as the same tool can be used for either



LATHE ATTACHMENT FOR TURNING ECCENTRIC PISTON RINGS.

right or left hand threads by inclining the tool to suit the pitch. The side clearance of a cutting tool may also be changed for various purposes.

In Fig. 1 the hole *A* in the central stud is a clearance hole and the tool or bar should not touch the sides of it. The coil spring *B* shown on the stud is used to

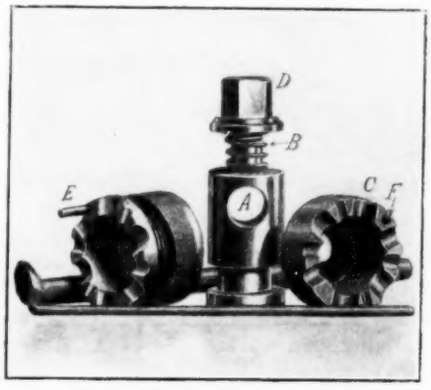


FIG. 1. DETAILS OF TOOL-POST.

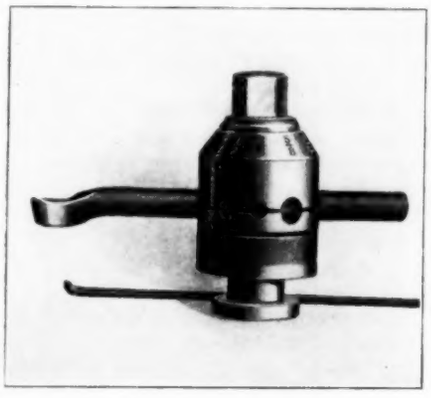


FIG. 2. TOOL-POST WITH TOOL IN POSITION.

raise collar *C* and release the tool when nut *D* is loosened. For convenience nut *D* should be made to fit footstock wrench. Dowel pin *E*, fitting loosely in hole *F*, causes the two collars to turn together when changing from one size of tool to another.

Fig. 2 shows the post assembled ready to place in the rest. I have made these posts to fit nearly all of the lathes in the steam engineering department at the Mare Island Navy Yard. One tool will take the place of at least half a dozen of the style now in use, as the same tool can be set out at any length to bore any hole within its range. For some lathes I made two posts—one to take small stock and one to take boring bars which we had on hand. For the larger sizes the elevating screw was left off of the bottom collar. The post is much more convenient than the tailstock spindle for holding drills, as the feed can be used.

When I devised this post I had no idea that anything of the kind existed, but on applying for a patent was informed that a patent had been issued to F. H. Carhart of Virginia for a post embodying the same principles. I have never seen it advertised and do not know of anyone who has. Perhaps some of your readers can inform us if they have ever seen anything of the kind on the market. F. H. SOVEREIGN.

A Press Work Trick.

We were all sitting around the heater at noon time when one of the toolmakers came in. He was a new man and had worked everywhere, from Maine to California. He said:

"Boys, I can show you a new trick with press tools."

"Well, what is it?" said the boss.

"It is this," said the toolmaker. "Stick two pieces of tin together with press tools without making a hole in either and use no rivets or solder and not bend the edges."

"Well, that is a trick," said the boss of the press job, who thought he knew it all and then he went off into space and after a while came back and said: "Come, tell us how you do it; I give it up."

Nothing loath, Ed went to work and shamed us. It seems he had been to work for a tin can company and the boss wanted a way to put on pail ears and he and Ed had worked the thing up together. Ed thought it was the intention to patent it, but he was not sure about it and has never been able to find out.

I show the two sets of tools as Ed showed us. The first set was to bump the recess in the pail to hold the ear. It was put on a horn die so you could slip the pail on and stamp it after it was all finished. The second set was to close down the edge around the ear. It was set in the same horn and had a strong spring sleeve *A* to start the edge in and then the punch *B* would come down and set the metal around the ear. Ed said it made a good, neat job and was a good thing; but he came away soon after and never knew if it was put to use.

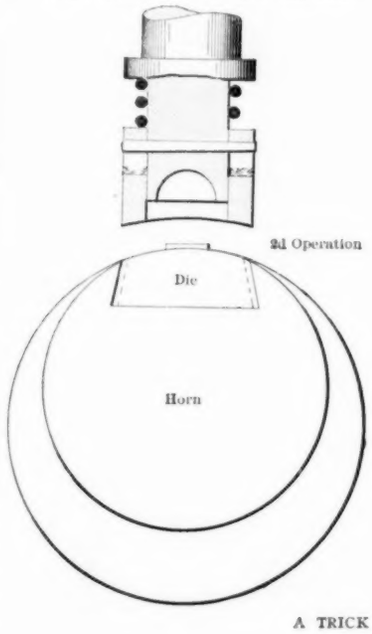
"Humph, it ain't much after all," said the pressroom boss. But I noticed he picked up the sketches that Ed made and I had hard work to get the loan of them to copy, as I thought it a good thing and would like to see it pushed.

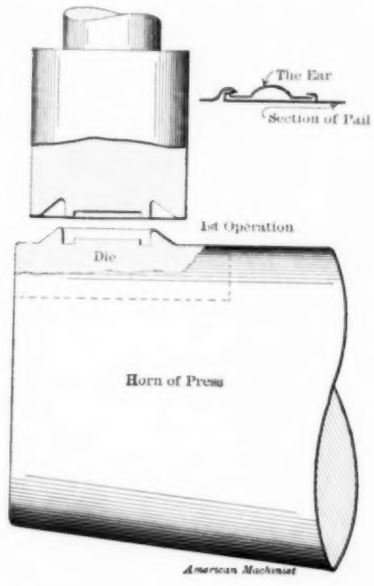
A. P. PRESS.

Sawing for Dovetailing.

Editor American Machinist:

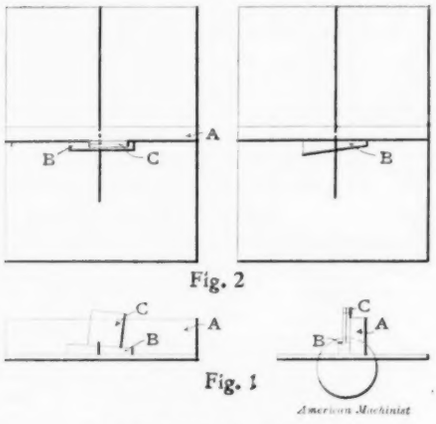
We recently had a job which called for a dovetailed box. Neither a dovetailing machine nor a Colburn saw was available for the work. A templet *B* was gotten out as shown in the three views of Fig. 1, and





A TRICK WITH PRESS TOOLS.

fastened to the circular saw carriage *A*. The ends of the box C were gotten out to size and fastened together. The saw was lowered to the proper depth, and after cutting to the lines on one side, then reversing and cutting the other side, the remaining stock was removed by a series of cuts. The only hand work necessary



SAWING FOR DOVETAILING.

was to smooth the bottoms of the mortises across the grain.

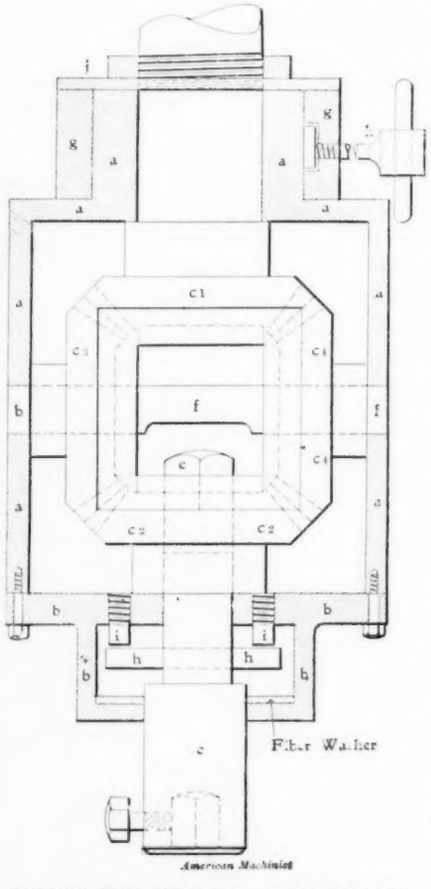
After the mortises were cut *B* was laid on its side as shown at Fig. 2 and the pins were cut. The box, having seven mortises and tenons on each corner, was completed in two and a half hours. Perhaps the method shown is not new to some readers, but I trust others may be found to whom it may be of service.

C. R. HARRIS.

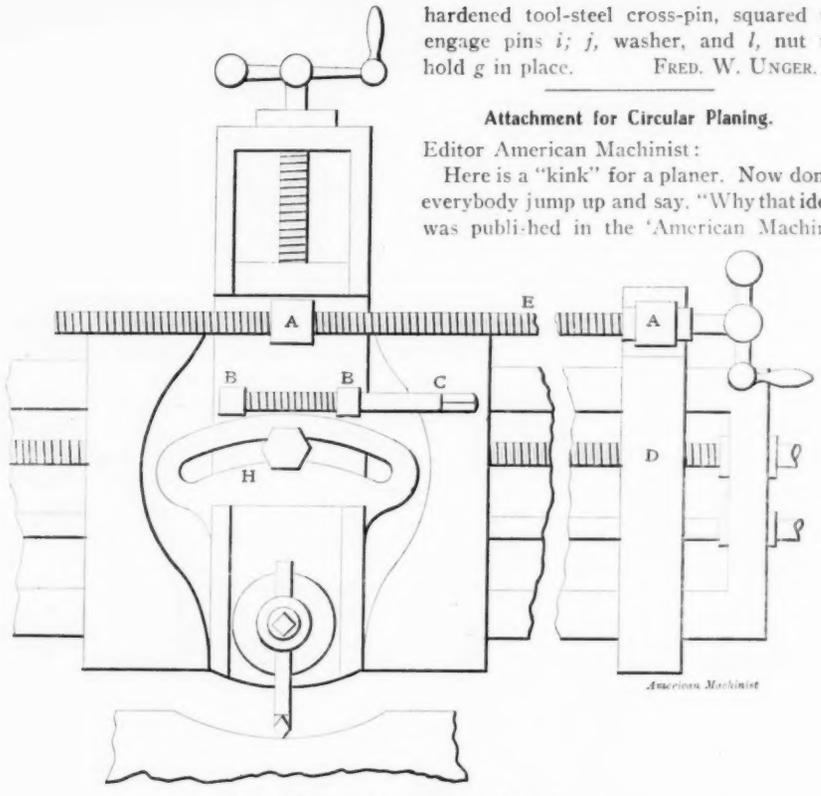
A Tapping Attachment.

Editor American Machinist:

I send you a sketch of a tapping attachment for an upright drill which I designed and made while employed at the shops of Townsend & Downey, shipbuilders, Staten Island. While not new in principle, it may interest some to see in detail how I did the trick. It may be well to understand how it is used first. When the tap is tapping, everything turns together as if it was all solid. If you have a stop set on the spindle, when it stops feeding down the tap still continues to feed until the cross-pin *h* disengages from the driving pins *i*, when the tap stops while the other parts continue to turn. You hold the handle *k* (which is considerably longer than here shown) and the collar *g* does not turn. Screwing in the handle *k*, thus tightening the friction, stops the main cylinder *a*, and then gear c^2 turns the other way, carrying the tapping socket and tap with it. When the tap is backed entirely out turn handle *k* the other way, releasing the friction, and everything is ready for tapping the next hole. The following letters of reference supply all needed information: *a*, the main cylinder or gear case; *b*, cap for cylinder; c^1, driving gear; c^2, driven gear; c^3 and c^4, intermediates; *d*, shank of gear c^1, fitting the drill spindle; *e*, socket for tap with upper end squared to slide in square hole in c^2; *f*, spindle for intermediate gears; *g*, friction collar; *k*, screw with handle to bind collar *g*; *h*, hardened tool-steel cross-pin, squared to engage pins *i*; *j*, washer, and *l*, nut to hold *g* in place. FRED. W. UNGER.



TAPPING ATTACHMENT FOR UPRIGHT DRILL.



ATTACHMENT FOR CIRCULAR PLANING.

Attachment for Circular Planing.

Editor American Machinist:

Here is a "kink" for a planer. Now don't everybody jump up and say, "Why that idea was published in the 'American Machinist' years ago," or "My father's grandfather's brother-in-law handed that design down to mechanical posterity." In these days of specialization I believe it is the practice for employers to confine the labor of a mechanic to one machine. As time hops along, I think perhaps it is better so, as it gives the operator a chance to find out and design quicker ways of getting out the finished product.

I have watched the platen travel backward and forward for five years, and during that time I have stumbled on to a few "kinks," some my own and some otherwise, that I have endeavored to incorporate in my work. This circle planing attachment is my own to the best of my knowledge.

A A are square pieces of steel with stems turned and threaded. One is screwed into the vertical sliding piece of the saddle and the other into an adjustable clamp *D*. The one in slide is threaded to receive lead screw *E* and the other has a plain hole to receive the unthreaded part of *E* with collars on each side. *A A* are not screwed in tight but swivel as required when the slide is moved by turning the screw. *B B* are studs similar to *A A* and bored to receive screw *C*. Collars (omitted in the drawing) hold the screw in position to move the quadrant to the full extent of the slot *H*.

The upper fixture is designed to machine large circles. The tie-bolts that hold the slide to the saddle are adjusted just tight enough to allow the slide to be moved. The lower fixture is for smaller circles and the tie-bolts that hold the quadrant

to slide are slacked sufficiently to allow it to move. Both fixtures are detachable and are handy potatoes in a toolroom or elsewhere. In practice the lower jigger is the handiest, as it allows the operator to move the slide up or down without interfering with the arc to be cut, while in operating the upper fixture the changing of the tool changes the radius. In all cases tighten the saddle to the rail.

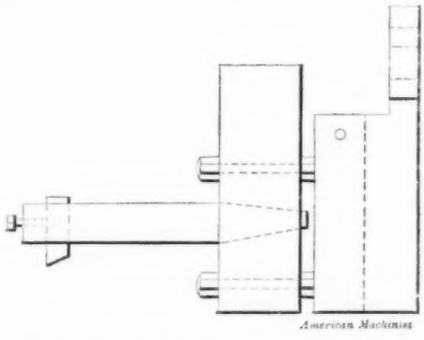
CARROLL ASHLEY.

Toledo, Ohio.

Tool for Internal Work on the Planer.

Editor American Machinist:

Referring to the tool-holder for internal work on the shaper, shown by Mr. Morgan at page 25, Vol. 25, I made a device



TOOL FOR INTERNAL WORK ON THE PLANER.

somewhat similar, for a planer, about three years ago. The accompanying sketch explains itself. The bar is made to project through the block slightly, which will allow of its being loosened by driving a wedge between the bar and apron when it is necessary to change the angle of the tool. The block projects above the top of the apron so that it can be blocked down when necessary.

McDonald, Pa. B. D. TILLINGHAST.

Contraction or Expansion of Steel in Hardening?

Editor American Machinist:

At page 19, L. O. W., in recounting his experiences with a lot of shells, speaks of the difficulty with the thread. "The Old Man said I should have known that steel would contract on hardening"; and as he calls down the Old Man quite freely for his other mistakes but does not contradict him on this one, he evidently is under the impression that steel does contract on hardening. Such, however, it not the case.

Without attempting to go into the theories as to why steel hardens—for all we have on this question is theory—I would like to speak of the idea I first held on the subject, as I believe it is one still quite commonly held by mechanics. It is assumed that a piece of tool steel being heated and made soft clear through, is plunged into water or some cooling liquid. The outside layer is immediately cooled and contracts on the soft center, compressing the center and making it more dense and therefore harder. As I said above, I believe this is the view commonly held by mechanics as to why steel hardens. The only trouble with the theory, so beautifully simple, is that a piece of steel is not contracted but expanded by the process of hardening. In time we learn this in the shop, as, for instance, when after having carefully fitted a steel stud we have it hardened and find it too large for the hole it had been fitted to.

If we plunge a block of hot steel into water we immediately chill the outer layer; this outer layer will *attempt* to compress the center, but the center, even though soft to the verge of malleableness, is not compressible; therefore the outer layer is stretched to a greater size than it had before the heating. When the center of the block cools, it will of course tend to pull away from the outside, thus setting up that combination of strains in a piece of hardened steel whose results so often lead the diemaker to ask himself whether life is worth living, as he sees his week's, often month's, work returned from the hardening in from two to a dozen pieces. This expansion of steel on hardening is the greater the higher the steel is in carbon; thus we have the greater difficulty with breaking dies when using harder steel; also its effect is cumulative, though at a decreasing rate. Thus any piece of steel in time must be broken by repeated hardenings, as the strain between the center and the outside becomes greater. This latter point I know is not appreciated as it should be by some people. I once had a superintendent say to me, referring to a die broken in rehardening: "That die has been in use in this shop for years, to my knowledge; it has been rehardened twenty times, and there is no reason why it should not be rehardened indefinitely." Annealing of course lessens the internal strains, and it also allows the piece of hardened steel to contract to a certain extent.

In Horne's "Metallurgy of Steel," page 29, and again at page 257, are given some figures showing the change of density some steel undergoes in hardening. It is about 7.83 unhardened, to 7.75 for hardened. If anyone wishes to pursue this subject further, I would refer him to Horne's work, as it probably contains the greatest amount of reliable information on the subject of any work yet published.

PERSEVERANCE.

Improving the Tapping Attachment.

Editor American Machinist:

At page 1359, Vol. 24, there are a letter and a sketch of a "Handy Tapping Attachment" from Mr. Winfred C. Rodger, Providence, R. I. Having designed a tapping attachment which has been doing good work for several years, and is in some respects similar, I offer the following suggestions for improvements: Make, in place of the stand or frame, a case that will keep chips, etc., out of the gears and clutch. Let the hub of the driving gear project through the case and be threaded to screw on to the spindle of the lathe, just as a face-plate would be, and have the full driving power of the lathe. A more valuable and important application would be to fit the attachment to a *turret* lathe if you have one; then by using fixtures in the tool holes in the turret, or on a bracket that can be screwed to the turret slide in front of and below the turret, the work will be threaded truer than if held by hand, as well as more easily by the operator, and the adjustable stop on the turret slide can be used to tap to the bottoms of holes or for threading work to shoulders as accurately as with a tapping machine. A. M. GORDON.

Plymouth, Conn.

The Traveling Mechanic—Force Fits.

Editor American Machinist:

I wish to make a few remarks concerning "Ver. I. Nier's" hobo machinist, page 9. While it is not necessarily a disgrace to be a traveling mechanic, it is, as a general thing, not considered a credit to the individual. My experience has been with that class of mechanic just the reverse of that of brother "Ver. I. Nier." In one shop that I have in mind, located where several railroads have a junction, I held the position of foreman for about six years. In that time we had quite a number of "traveling mechanics," and we were willing, from our experience with 95 per cent. of them, for them to keep on traveling. We always had men in our shop who could discount 99 per cent. of these hobo gentry on our class of work. It may be that the rolling stock of mechanics in "Ver. I. Nier's" neck of woods is superior to that in my vicinity, or perhaps the shop mechanics are inferior.

As to the man who has been employed in one shop for forty-one years and his regrets that he has never made a move; I can feel for him. He must have been a good man to have held a job so long. The nineteen-year man also has my sympathy, but perhaps he deserved his sentence.

As to those 4x12-inch "air-tight" cylinders, I have worked with plenty of mechanics who could make those fits, but we called them "iron and iron" fits. I would like to see these cylinders and plungers working "air tight."

Speaking of fits, shrunk, drive, sliding and misfits, our principal work is in that line. Our work is almost all in cast-iron drive and shrink fits, shrinking cast-iron bushings from 3 to 16 inches diameter and driving fits from 4 to 52 inches, internal and external. The thickness of metal varies from 5-16 to ¾ inch, the bushing running from 3 to 8 inches long. Our ratio of loss is about 3 per cent., sometimes caused in cooling shrink fits, when the bushing has been heated too much and expanded so as to allow the water to run between the work and bushing, generating steam and causing an explosion, and sometimes caused by what is

"technically" called a misfit. As to rules for driving fits there are none, and as far as large fits are concerned, there never will be any.

The three things essential in making a fit of any kind are a pair of outside and of inside calipers and a mechanic at the back end of them who can use his head and hands at the same time. The rule that will apply to force fits on one grade of iron will not do on a harder grade, and a rule for iron or steel fits will not work on brass. I am afraid we would find very few shops equipped with the necessary tools for calipering, say, from 12 to 36 inches or larger by micrometer measurements. In a 36-inch caliper there is considerable deflection, as anybody may discover by calipering vertically and then calipering horizontally. In regard to using paper to assist in making fits, where I was "cubbing" my instructions from our foreman for both shrink and force fits were as follows: "Find the exact size of the shaft; bore the hole to just the fraction of a *red* hair smaller than the shaft, and drive on." I found the exact fraction by experience and my own judgment, and have had fairly good success in both force and shrink fits by the use of this formula. J. G.

Ethics of Job Work.

Editor American Machinist:

Referring to your recent editorial on "Some Jobbing Shop Problems," concerning this subject it seems to me that what is needed is a liberal application of healthy common sense and a desire to do justice. Shops building machinery and selling it in competition with others are perforce obliged to cover the losses from poor workmanship, bad castings and broken tools by adding a percentage to the selling price of the product. This percentage is not always added equally to the prices of all lines of the product, but is sometimes borne chiefly by the product which is the most profitable. There is no valid reason why much the same system could not be applied to a jobbing shop. In fact it is impossible to do justice to all customers without carrying out this principle more or less completely. When the shop owner hires men he assumes responsibility for all mistakes made by his workmen, and when he does a job for a customer he practically agrees to do the work as well and as cheaply as he can get it at any other job shop. If he did not do this he would not get much work to do. Having agreed to this, if his workmen spoil a piece, making the job cost perhaps twice as much, and the customer is charged with it, he must pay double what he might have paid for the same job at another shop, or in case he had a like piece done at different times, in the same shop, he would pay double the price on one occasion. Or again, two different customers might have similar jobs done at the same shop, and one might be charged much more than the other. It ought to be perfectly obvious that there is an injustice perpetrated here which should be avoided. That it is not avoided is due either to ignorance or deficient moral sense and courage. To avoid the trouble, charge all such losses to the profit and loss account and raise the shop rate enough to cover it. If this cannot be done, it is about time to make an assignment or appoint a receiver.

In carrying out the principle in a job shop more judgment is required than in a shop making a standard product, because the time spent on a job is one of the factors in making out the bill for it. If this is done in an entirely routine manner in the shop and office, it will often work an injustice to customers. All bills, before being sent out, should be inspected by the foreman or some man who is competent to do so, to see if there are any overcharges or mistakes in them, and if for work similar to that done at a previous time, should be compared with it, and if there is apparently too much difference, the reason should be discovered if possible.

If, after inspection and comparison, the bill seems too high, it should be changed so it will be only a just charge to the customer. I have a number of times been called on to pass judgment on bills rendered for job work, and I find it not an uncommon thing to see bills in which there is a glaring hiatus between the work done and the price charged for it.

It is, however, not always the fault of the shop that jobs cost more than they should, for customers sometimes insist on having things done in their own way, against the will and judgment of the shop management, and then, if not satisfactory, want to blame the shop for it. This is one of the most disagreeable features of the jobbing business, for which I can offer no fully satisfactory remedy.

Regarding the matter of broken tools, they are not valid evidence that a job is being pushed along at the best speed. The best of men of course will sometimes break a tool, but every experienced foreman knows that the men who break the most tools are not the best workmen. Breaking of tools is more often the result of reckless use or lack of deftness of hand, than to being crowded beyond their strength for legitimate use. There are generally in every shop one or more men who are noted for the number of tools they break, but I never knew one of this sort to be the best workman in the shop. They are sometimes good men on certain kinds of work, but the good, all-around mechanic who can always be depended on to do the best on a job is never an habitual tool breaker.

In job work, a certain machinist might break a $5 drill doing a $1 job for a customer, while in a previous job he used the same drill on a job worth $6, and it ought to be perfectly obvious that it would not be just to charge $6 for the last job because the drill happened to be broken while doing it. Of course this is perhaps putting it in an extreme way, but it shows that it is essentially a wrong idea.

The cardinal principle in the matter ought to be, that no customer should be charged for anything on a job which plainly was not properly required for the doing of that particular job. Keeping this in mind, it ought not to be exceedingly difficult to do substantial justice to all customers. BELL CRANK.

A Co-operation Plan Under Which Molders Own Shares in a Foundry.

Editor American Machinist:

Co-operation has been tried during the last year at the Bowler Foundry, Cleveland, Ohio. At the first annual meeting just held it was reported that the new plan had been beneficial to employees and owners alike. During the molders' strike about a year ago the Bowler Company was organized into a stock company and incorporated with a capitalization of $75,000, of which $30,000 was paid in. The employees were given a chance to buy shares at terms that made the purchase easy, and thirteen of the molders out of the fifty employees of the company bought stock. Most of the men hold from two to five $100 shares and one molder has forty of the shares. Ownership of the shares makes them part proprietors of the business. During the year the company has had no labor troubles of any kind, and at the annual meeting the men were enthusiastic in their approval of the co-operative plan. Mr. N. P. Bowler said that he had for a number of years believed that such a co-operative plan as the company had tried would be advantageous, and he was glad to find that it had been a complete success. One of the features of the meeting was a dinner at the Forest City House and an evening at the Empire Theater afterwards, the stockholders being the guests of Mr. W. C. Bruce, the president of the company. The other officers are: N. P. Bowler, vice-president; F. W. Bowler, secretary and treasurer; G. W. Balkwell, engineer. The officers, with Mr. Chas. Cunz, compose the board of directors.

For my part I think that it is better than the premium or bonus plan, or any other of the plans to make a man work harder. I was in this shop some time ago and found all the men in the shop doing their best, to get a little money for a rainy day, besides working for themselves. That is a great inducement, and another thing is that their industry is an incentive to those who are not stockholders in the shop. What do you think of it?

THOS. WATHEY.

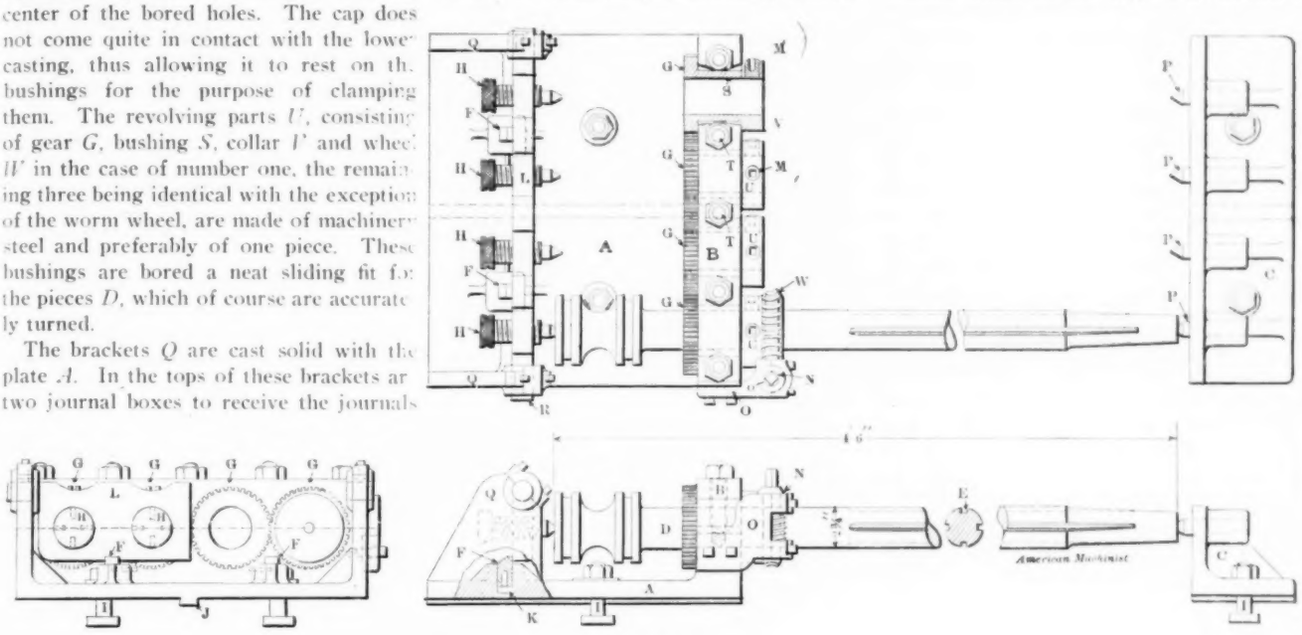
A Milling Jig.

Editor American Machinist:

In the accompanying drawing are shown three views of a jig designed for the rapid milling of the slots *E* in the piece *D*, the

grooves to be accurately spaced within a fair limit. As will be seen, the casting *A* is planed on the under side, a tongue *J* fitting the milling-machine table. The cap *B* is held by the studs *T*. The joint between the cap and the casting *A* is at the center of the bored holes. The cap does not come quite in contact with the lower casting, thus allowing it to rest on the bushings for the purpose of clamping them. The revolving parts *U*, consisting of gear *G*, bushing *S*, collar *V* and wheel *W* in the case of number one, the remaining three being identical with the exception of the worm wheel, are made of machinery steel and preferably of one piece. These bushings are bored a neat sliding fit for the pieces *D*, which of course are accurately turned.

The brackets *Q* are cast solid with the plate *A*. In the tops of these brackets are two journal boxes to receive the journals



A MILLING JIG.

R on the ends of the resistance piece *L*. This piece is bored and threaded for the four adjustable tool-steel centers *H*. *L*, when in its normal position, is prevented from swinging outward or backward by the plugs *F F*. In the lower end of each of these plugs there is drilled a hole into which is inserted a light spring of sufficient strength to sustain the weight of the plug and keep it up to the limit of its travel. In the sides of the plugs small pins are placed to prevent the plugs from falling out and also to enable the operator to press them down when it is desired to release the swinging piece *L*. The end view, with half of the resistance piece *L* removed, shows the arrangement of the gears.

The index bracket *O* is set into the casting *A* and is made a good fit to prevent any movement. The worm, its shaft and index collar are made in one piece. The outer edge of the collar is beveled, and can be graduated to suit the conditions, a line being placed on the upper face of the bracket with which the lines on the collar are made to coincide in the usual manner.

The angle plate *C* is a plain casting drilled for holding down bolts *I* and bored and reamed for the steel centers *P P*.

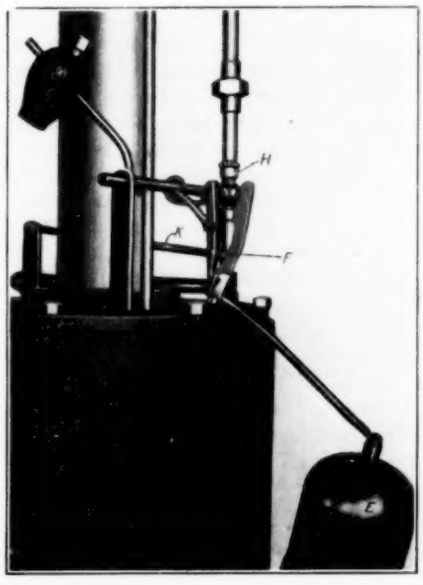
In using the jig the piece *L* is swung up out of the way. The pieces to be milled are placed in position by sliding them through the bushings. The swinging piece *L* is brought down and forced over the stops *F F*. The centers *H* are then tightened, either by hand or with a lever, holes for which have been provided. The screws *M* are screwed down upon the piece *D*, the marks on the bracket and index collar are brought in line and the cap *B* is tightened. After the first groove has been milled, the nuts holding cap *B* are slackened sufficiently to remove any unnecessary friction between the bushings and their bearings and the pieces are turned to the next position.

S. B. McQUADE.

Compressed Air Oil Service.

Editor American Machinist:

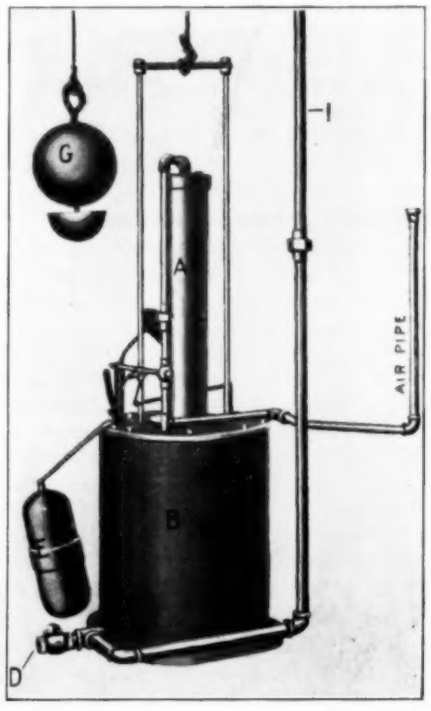
Not all rotary oil pumps supplied with machines for lubricating their cutting tools are entirely satisfactory. There is usually trouble with leaky joints, or the belts get oilsoaked and throw oil over everything within reach. It often happens that the oil supply is not needed, but still the pumps keep running, wasting work.



DETAILS OF OIL ELEVATOR.

All these conditions existed in the case I am about to speak of. The pump, getting intolerable, was taken out and a tank set on brackets above the machine was substituted. From a tank below the attendant would fill the upper tank as often as needed, but as he had to do some climbing this arrangement was not satisfying.

There was in the shop a constant supply of compressed air at 70 or 80 pounds pressure, which I concluded to use, and the photographs show the result. *A* is a 3-inch brass tube serving as an air cylinder, *B* is a cast-iron cylinder about 14 inches inside diameter. Pistons connected by a



COMPRESSED AIR OIL ELEVATOR.

rod are fitted to each cylinder, and cup leathers are used for packing; the rod has no packing. The apparatus is single acting, and the pistons are returned to the upper position by the counterweight *C*, through the rope and rods shown. The whole thing is set into a tank, not shown, into which is led the used oil. The oil rises on the inside of cylinder *B* as well as on the outside, passing in through the check valve *D*. A small hole through the side of cylinder *B*, near the top and close under the lower piston when it is up as far as it will go, allows the air to escape, and it is closed as soon as the piston descends a distance equal to the diameter of hole. When the oil is high enough the float *E* trips the hook *F*, the weight *G* falls and opens the air valve *H*, admitting air on top of the small piston. The pistons descend and the larger one forces the oil in cylinder *B* to the upper tank. When the piston is near to the lower limit of its travel, it strikes the rod *K* which passes through the cylinder *A*, and this lifts weight G in position for another "cycle." It should be noted that the trigger on the float remains in a position to interfere with the hooking up of weight *G* until the pistons return, and must be constructed accordingly.

The releasing mechanism was first made very cheap and too flimsy, otherwise the operation seemed to be good; so it was replaced by better, and after that it worked entirely satisfactorily for several years, and so far as I know it is working still. The time of making it complete and installing was thirty-five to thirty-eight hours, and afterwards eight to ten hours for a new tripping mechanism. It required no attention except cleaning out; but if I had to make another I think I should dispense with the pistons and admit the air on top of the oil, and, so to say, "blow it up."

The advantages as I see them are: cleanliness, no belts, no bearings, noiselessness and no motion except when wanted. H. F.

Method of Sinking a Drop-Forge Die.

Editor American Machinist:

To sink a pair of forging dies for the butt or breech plate of a gun involves a great deal of hand work and a considerable amount of care if one is to do a good job. I had several pairs of such dies to sink at one time, and the purpose of this article is to show to the readers of the "American Machinist" a scheme I devised to make the machine help me some on the job.

I am too much of a Yankee to have any love for hand work, and if there is much ahead of me, am apt to work my gray matter overtime if necessary to get a scheme to avoid it. The one shown by the accompanying sketches did not eliminate all the hand work, but it did help a lot.

a shows the piece which was to be forged —the well-known butt plate of a military rifle. The dies were what are termed "match face" and are shown by *b* and *c*, *b* being the bottom and *c* the top die in the drop.

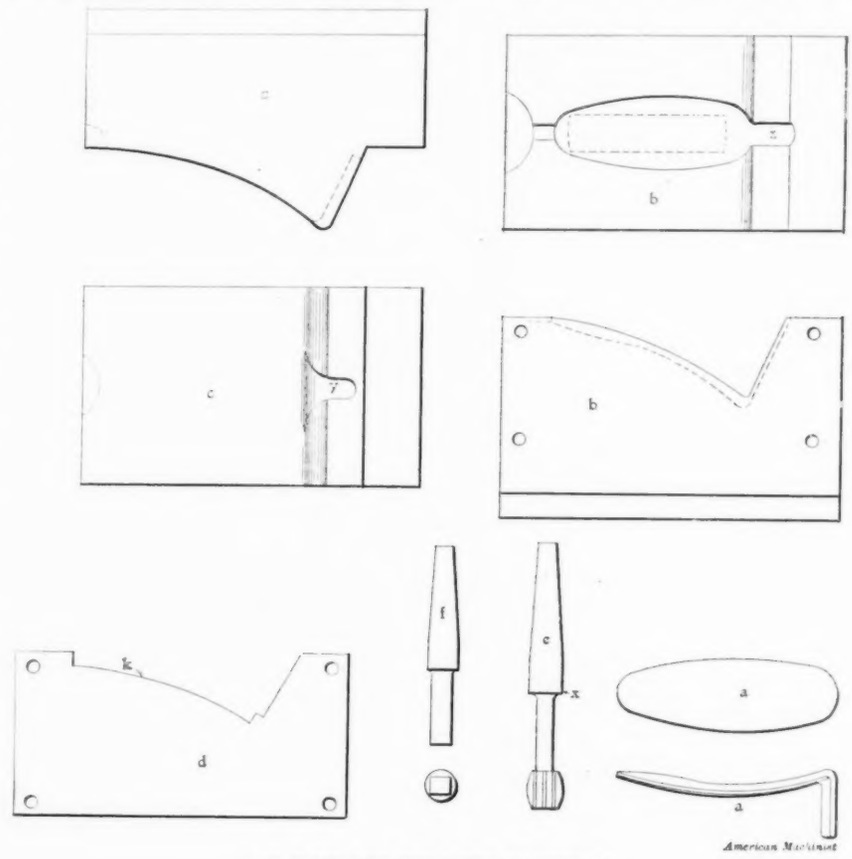
The plate was to be redropped—that is, forged, pickled to remove scale and redropped at a heat so low that it would not scale, thus giving a surface which could be finished on the polishing wheel and the edges only were machined.

I chipped and filed the entire bottom impression in the first pair, and when we got some samples our military inspector put his micrometer on them just as cheerfully as he did on a piece of machined work, and insisted that they come within two thousandths of the drawing at the two thickest points, they being the only places where he could apply his caliper. All argument was in vain; he must have some samples like the print, and to get them out of this pair involved a whole lot of scraping and grinding on the tempered die, accompanied by lots of uncharitable remarks about the inspector.

Visions of the pairs of dies to follow haunted me in the small hours of the night and caused the making of the former-plate *d* and cutter *e* which solved the problem very nicely.

The line *k* on *d* was filed as near to shape as possible, secured on die *b* by the pin holes shown, and a cut made with the cutter *e*; *x* acting as a former-pin, a strip of lead was then placed in the cut and the dies squeezed together, giving a form which could be measured with a micrometer, and by filing and cutting in this manner I was able to get a templet or former that corresponded exactly with the drawing. With this former and the cutter *e* the dies were quickly machined, as shown by the dotted lines on *b*, and an accurate outline secured at every point where the inspector could apply his gage.

There was lots of chipping and filing left still, but the cut, exact as to form and depth, was a great help and gave assurance at the start that the die would be O. K. at the points where it could be measured, and a lot of time was saved on the job.



A DROP-DIE AND TOOLS FOR MAKING IT.

The cut *y* in *c* was easily machined and the cutter *f* was made to machine *z* in *b*, the spindle being stopped and the machine used as a slotter, which did the job much better than it could be done with chisel and file and in a fraction of the time.

The dies warped very little in tempering and samples were secured which were quite satisfactory, though I doubt if the methods used to get them would prove commercially profitable. THEODORE.

The National Bureau of Standards.

We have previously mentioned the establishment by authority of Congress of the National Bureau of Standards at Washington, and a short while ago had the pleasure of a call by Dr. S. W. Stratton, the director of the bureau, who in addition

to his scientific and technical attainments is obviously endowed with a liberal degree of what we are in the habit of calling "horse sense" and who is especially desirous that the new bureau shall be made useful to the manufacturers of the country. Dr. Stratton sends us the following statement regarding the bureau and the work it is prepared to undertake:

By an act of Congress approved March 3, 1901, the Office of Standard Weights and Measures of the Treasury Department was on July 1, 1901, superseded by the National Bureau of Standards, the functions of which are as follows: The custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

The bureau is authorized to exercise its functions for the government of the United States, for any State or municipal government within the United States, or for any scientific society, educational institution, firm, corporation or individual within the United States engaged in manufacturing or other pursuit requiring the use of standards or standard measuring instruments.

For all comparisons, calibrations, tests or investigations, except those performed for the Government of the United States or State Governments, a reasonable fee will be charged. Provision is also made for the purchase of a site and the erection of a suitable laboratory, its equipment with the most improved facilities and the personnel necessary for the organization of the bureau.

A suitable site has been selected in Washington in a locality free from mechanical and electrical disturbances, and yet easy of access. Plans are being prepared for a physical laboratory which will be equipped with apparatus and conveniences for carrying on investigations, and for testing standards and measuring instruments of all kinds. Also a somewhat smaller building, to be known as a mechanical laboratory, which will contain the power and general electrical machinery, the instrument shop, refrigerating plant, storage batteries, dynamos for experimental purposes, and laboratories for electrical measurements requiring heavy currents.

The construction of the buildings will be pushed as rapidly as possible, and it is expected that they will be ready for occupancy by January 1, 1903. For the present additional quarters have been secured in the building occupied by the former Office of Standard Weights and Measures, with a view to the organization of the bureau and the immediate development of the more needed extensions of the work heretofore carried on, such as photometric measurements, the testing of instruments for determining high or low temperatures, clinical thermometers, chemical glass measuring apparatus, electrical apparatus used to measure alternating currents, pressure gages, and meteorological instruments.

For the present, however, the work of the bureau will be limited to the comparison of the following standards and measuring instruments, either for commercial or scientific purposes:

Length Measures.—Standard bars from 1 to 10 feet, or from 1 decimeter to 5 meters; base bars; bench standards; leveling rods; graduated scales; engineers' and surveyors' metal tapes 1 to 300 feet, or from 1 to 100 meters.

Weights.—From 0.01 grain to 50 pounds, or from 0.1 milligram to 20 kilograms.

Capacity Measures.—From 1 fluid ounce to 5 gallons, or from 1 milliliter to 10 liters.

Thermometers.—Between 32 and 120 degrees Fahrenheit, or 0 to 50 degrees Centigrade.

Polariscopic Apparatus.—Scales of polariscopes, quartz control plates and other accessory apparatus.

Hydrometers.—Alcoholometers, salinometers and saccharometers, whose scales correspond to densities between 0.85 and 1.20.

Resistances.—Standard coils of the following denominations: 1, 2, 5, 10, 100, 1,000, 10,000, 100,000 ohms; low-resistance standards for current measurements of the following denominations: 0.1, 0.01, 0.001, 0.0001 ohms. Coils of resistance boxes; potentiometers; ratio coils.

Standards of Electro-motive Force.—Clark and other standard cells.

Direct-current Measuring Apparatus.—Millivoltmeters and voltmeters up to 150 volts; ammeters up to 50 amperes.

It is the desire of the bureau to cooperate with manufacturers, scientists and others in bringing about more satisfactory conditions relative to weights and measures in the broader meaning of the term, and to place at the disposal of those interested such information relative to these subjects as may be in possession of the bureau. All communications and articles should be addressed "National Bureau of Standards, Washington, D. C."

S. W. Stratton, Director.

Washington, D. C., January 1, 1902.

Report of New York State Factory Inspector for 1900.

We have received a copy of the Fifteenth Annual Report of the Factory Inspector of the State of New York for the year ending November 30, 1900. It comprises 927 pages of statistics and other information about the conditions in the manufactories of the State, principally in regard to compliance with the laws regulating hours of labor and safety of employees, etc. Incidentally it gives the number of employees of the several factories or a very large proportion of them, and therefore is useful as a book of reference.

An interesting case of legal inadequacy cited in the report is as follows: There is a law restricting the employment of male minors under the age of eighteen years, as well as all females, upon certain kinds of polishing and buffing wheels. Under a clause of this law an attempt was made to convict an officer of a large manufacturing concern for the employment of a boy less than sixteen years old on an emery polishing belt. At the trial the facts of the case were admitted, but the defense claimed that the prohibitive clause of the statute did not specifically mention the kind of polishing machine on which the boy had been employed and that the defendant could not be held, as the law must necessarily be strictly and literally construed. This contention was sustained and the complaint dismissed.

The following is a list of the different machines on which fatal accidents have been reported, with the number of accidents upon each: Elevators and hoists, 9; fuel gas, 1; pulleys and belts, 4; planer, 1; dough mixer, 1; flywheel, 1; fall, 3; emery wheel, 1; engine, 1; digester, 1; explosions, 5; edger, 1; paper reel, 1; saw, 1; shafting, 6; crane, 3; car, 1; no machines, 2; total, 43. The machines on which accidents have been reported (either irrespective or exclusive of fatalities) are as follows: Saws, number of accidents, 142; gearing, 46; elevators and hoists, 83; presses (all kinds), 217; calenders, 15; pulleys and belting, 72; lathes, 33; cotton and woolen machines, 130; flywheels, 3; emery wheels, 30; buffers, 7; planers (all kinds), 37; stamping machines, 2; setscrews and shafting, 43; drop and steam hammers, 32; dough mixer, 1; wood-working machines, 27; shapers, 13; boring machines, 2; tumbling mills, 10; jointers, 28; digester, 1; cranes, 33; shears, 23; staying machines, 22; piston rod of engine, 1; looms, 78; miscellaneous machines, 248; no machines, 977; total, 2,365. For classifying explosions as "machines," it is the factory inspector, not we, who is responsible.

The Buffalo Forge Company, Buffalo, N. Y., has adopted a custom of calling together, at the beginning of each year, as many of its engineer-salesmen from its branch offices as feasible, in order to interchange ideas. Such a conference was held through the first week of 1901, with results which were felt all the year. A similar meeting was held this year. The company issues invitations to those who are to attend, asking each one to prepare a paper or technical article on an equipment furnished within the past year, to be read and discussed at the conference. A picture of the visiting group, which we have seen shows a bright looking set of men.

AMERICAN MACHINIST

Published at 218 William St., New York, every Thursday by the

American Machinist Press.

[INCORPORATED.]

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

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The Policy of the United States Steel Corporation.

The annual meeting of the stockholders of the United States Steel Corporation is to be held February 17 and the preliminary report of the management, made for presentation to the stockholders at that meeting, has been made public. Granting, as for the time being at least we must, that this report states facts, the consuming interests may feel reassured regarding the present policy of the corporation. This policy is, of course, shaped to further the interests of the corporation as those interests are seen by its managers. Different minds might, however, arrive at very different conclusions regarding what course is most likely to serve those interests and it is gratifying to know that for the time being the decision regarding this policy is one to which no one can take exception. We quote the following passage as of chief interest to the public:

"The demand for the products of the several companies has been so great that prices could easily have been advanced. Indeed, higher prices have been voluntarily offered by consumers who are anxious for immediate execution of orders, but the companies have firmly maintained the position of not advancing prices, believing that the existing prices were sufficient to yield a fair return on capital and maintain the properties in satisfactory physical condition, and that the many collateral advantages to be gained in the long run by refusing to advance prices would be of substantial and lasting value, not only to the company, but also to the general business interests of the country. The strong position taken by the company for stability in prices both of raw material and finished products has had a reassuring effect on the trade, and has contributed greatly toward restoring confidence in the general business situation, and creating the present large demands for steel products by dispelling any doubt as to prices in the future."

The prices of iron and steel products are in the nature of things excessively mercurial. There is probably no great line of staple products which are affected so quickly and so powerfully by the law of supply and demand. The reason for this lies in the fact that, in spite of the enormous production, the amount of accumulated material on hand at any time when production and consumption are fairly balanced is relatively small. An increase in consumption quickly exhausts this reserve and, as the needs of consumers are imperative, the exhaustion of the reserve naturally leads to soaring prices. On the other hand, a slackening of consumption as quickly leads to a rapid increase in the reserve with a corresponding weakening of prices—the change in either direction being far in excess of that legitimately due to the amount of increase or decrease in consumption. This condition of things has always been the bane of the iron and steel trade, and it is this which makes that trade the great barometer of the business world.

If the Steel Corporation is to use its power as a steadying influence it may be of large benefit to the general business interests of the country. The dangerous feature of the situation lies in the fact that matters of such vast importance rest upon the decision of a few men. The present policy of these men appears to be an enlightened one, but there can be no guarantee of its continuance. That policy must always be determined by their views regarding the interests of the corporation. The present managers may change their views, and, if they do not, they are certain to have successors who may, and very likely will, look at the matter differently. While, therefore, the public may feel reassured regarding the immediate future no such reassurance is possible regarding the more distant future. Regardless of any present policy we cannot but feel that so much power lodged in the hands of a few men leads to a dangerous and unnatural situation, and may at any time act prejudicially to machinery interests, and especially to our foreign machinery trade.

Some Statistics of Manufactures.

Some advance figures have been given out at Washington derived from the United States census of 1900 as follows: Number of establishments, 512,585; increase, 44 per cent. Capital, $9,853,030,789; increase, 51 per cent. Wage earners (average number), 5,310,598; increase, 25 per cent. Total wages, $2,323,407,257; increase, 23 per cent. Miscellaneous expenses, $1,028,550,653; increase, 63 per cent. Cost of materials used, $7,349,916,030; increase, 42 per cent. Value of products (including custom work and repairing), $13,019,251,614; increase, 39 per cent.

These figures do not include establishments whose annual product is less than $500.

It will be noticed that while the number of establishments increased 44 per cent. in ten years the amount of capital employed in them increased 51 per cent., which shows the average increase in size and amount of capital employed in manufacturing establishments. The increase in number of wage earners is only 25 per cent., or a little less than half the increase in the amount of capital employed, which shows the increased use of automatic and other machinery by which the number of employees is decreased in proportion to the amount of capital employed; while the increase in amount of wages paid is still less, showing that average wages declined within the ten years—probably due mainly to the relatively larger number of unskilled or only partially trained workmen employed, as compared with the highly skilled who are probably getting as high and perhaps higher wages than in 1890. "Miscellaneous expenses" is an indefinite term, but probably includes repairs, insurance,

advertising, etc. Cost of materials shows a 42 per cent. increase, while the value of product shows only 39 per cent., which is less than the increase of capital and of materials, but more than the increase of wage earners or of total wages paid.

Applying the slide-rule we get some round numbers that are interesting and instructive. These show that the average manufacturing establishment employs ten wage earners and pays them each $435 per year in wages; that it employs $19,200 capital, or $1,860 per employee; produces $25,500 worth of goods, or $2,450 per employee; pays $14,400 for its material, or $1,300 per employee, and that after paying per employee $435 wages, $202 miscellaneous expenses and $1,390 for materials, there is left $423 per annum per employee out of which to pay all items of expense not enumerated and for profits. The figures show, we think, a much more prosperous condition of affairs for industries generally than would be shown by machinery building interests alone.

The machinist has undoubtedly been the chief instrumentality in bringing about the the changes shown by the figures, and it would be interesting to know just how his own art has been affected and whether or not the same tendencies are shown in the same degree in machinery building establishments as are shown in all manufacturing industries taken together.

A press despatch from Odessa says that the total cost of the great Siberian Railway has been approximately calculated, officially. Its length is given as 5,190 miles, while the expenditures so far incurred have been 780,000,000 rubles (about $390,000,000). It is estimated that when the road is completed the total outlay will amount to 850,000,000 rubles (about $425,000,000). It is stated that the greater part of the permanent way will have to be practically relaid within a few years, the work having been very poorly done, and experts declare that Russia has paid a high price for the work, considering its quality. Perhaps this has some bearing upon the dictum of a well-known English contractor, who had built railroads in practically every part of the world where railroads are used. He declared that as a result of his experience he did not attach much importance to the rate of daily wages paid to men working in railroad construction, but said that the cost of the work would be practically the same in any part of the world regardless of the rate of wages per day. This, we suppose, is in accordance with an economic law that workmen employed in the construction of a railroad must at least earn their sustenance (they usually earn little more) and that their sustenance if good and of a character to sustain them in good physical condition will enable them to perform more work and they will do more work than if this sustenance is poor and cheap, and results in lowered vitality and energy, the quality of their sustenance being of course measured by the rate of wages paid them.

It is reported from London that the "iron masters" and their men have come to an agreement under which there will no longer be any restriction of product in English iron works, the statement being made that Thomas Bayley, M. P., on behalf of the employers appealed to the workmen to support the efforts of their employers to increase the production and that Mr. Cox, responding on behalf of the men, said that there would be no longer any effort to restrict such production, but that the employers would hereafter receive full benefit of the money expended in improved machinery and appliances.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

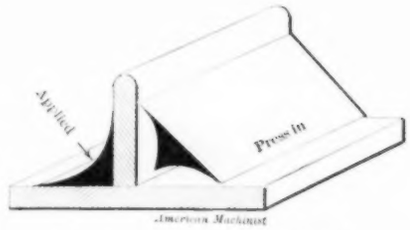
(3) W. B. H., Chicago, asks: Is it considered good practice to babbitt loose pulleys for countershafts? A.—Many loose pulleys are babbitted, but the majority have plain cast-iron hubs. The latter if properly lubricated, and if the belt is not too tight, seldom give any trouble. The loose-pulley question is one of lubrication almost entirely.

(4) S. B. Machine Company asks: In a long line shaft with driving pulley in the middle would the shaft have to be as large as it would be if driven at one end? A.—The term "long line shaft" is rather indefinite. If the line shaft is so long as to make the torsional stress near the driving pulley the most important stress imposed upon the shaft, then it might be advisable to make the shaft near the driving pulley larger in diameter than the rest of it, no matter whether it be driven from a point near the middle or from one end. In fact, it is a common practice to make one length of the shaft larger in diameter to take the driving pulley in order to secure large bearings and needed rigidity of the shaft at that point. For convenience of changing pulleys, couplings, etc., it is customary to make the diameter of a line shaft the same throughout, and practically, for all moderate lengths of shafts, this diameter should be the same whether the shaft is driven from the middle or from one end, because ordinarily the size of a line shaft is determined by practical considerations other than the pure torsional stress to which it may be subjected.

Some New Things.

LEATHER FILLET FOR PATTERNS.

The cut shows the peculiar features of the leather fillet for patternmakers made by A. G. Butler, 99 Beekman street, New York city. The front shows the original shape or section of the leather, and the

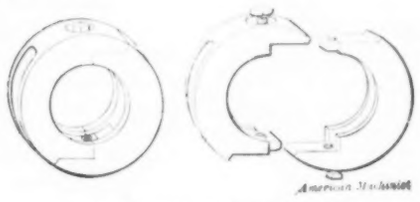


LEATHER FILLET FOR PATTERNS.

back shows its shape when glued in place. The thin edges blend with the flat pattern surface, so that there is no perceptible joint, and a perfect arc is formed. The fillet can of course be applied to curves as well as to straight work, and no tacking or clamping is required.

AN INK BOTTLE HOLDER.

The half-tone shows a holder for bottles of drawing ink, to prevent their accidental tipping over. As Higgins's 2-ounce bottles are so generally used, the first patterns were made to conform to this general custom, but these holders are now made for other shapes and sizes. The bottle is slipped in from below and is clamped by a plate and two screws under the bottom. The neck of the bottle projects so that it is just as handy for moving, cleaning or filling as if not in the holder. When used on a slanting board a thumb tack may be thrust through the little hole in the recess at the side. These holders are made by A. B. Christman, 18 Plymouth street, Cleveland, Ohio.



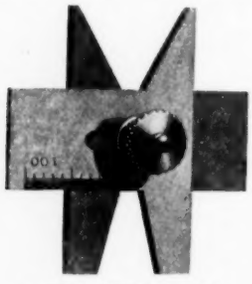
A SAFETY COLLAR FOR SHAFTING.

One of the most dangerous and in every way objectionable familiar things is the solid collar with the projecting square head set-screw, and any substitute for it is to be welcomed. The collar shown in the cuts speaks for itself and requires no

explanation as to its operation. The screws are tapped into both ends of each half, and are cup pointed, so that the collar is held securely against lateral thrusts. The heads do not project above the surface of the collar. The collars are made in all sizes by the National Tool & Machine Company, Reading, Pa.

THE EAGLE PIPE WRENCH.

Frank Mossberg Company, of Attleboro, Mass., have brought out the pipe wrench shown by the accompanying engraving, and the principle of which will be readily understood. In placing it upon a pipe all that is necessary is to open it wide enough to take the pipe between the jaws, close the jaws upon it and proceed to turn. A movement of the wrench in the opposite direction instantly loosens it. For simplicity this wrench could hardly be surpassed. It is recommended as especially useful for those who have to do with automobiles. Its length is 6 inches, its weight 8 ounces; it is made of steel, drop forged, with hardened jaws, and is known as the "Eagle" pipe wrench.

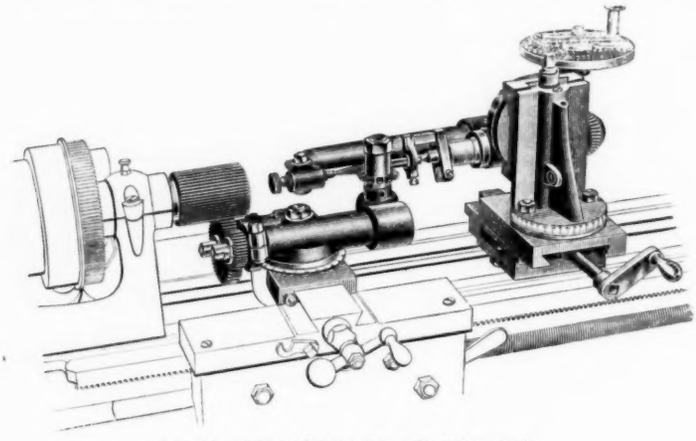


A NEW THREAD GAGE.

The newest idea in thread tool gages is sent us by our contributor, A. B. Christman, 18 Plymouth street, Cleveland, O., who says a patent has been applied for upon it. It is for gaging tools for cutting United States standard threads, worm cutting tools or milling cutters, etc., and is set to the required width as shown by a table. The two pieces of which it is made are identical in every particular, except as to graduations. These graduations may serve for most purposes for which the gage may be used, but where greater accuracy is required, a micrometer can be applied to the outer parallel surfaces of the jaws, and, the distance over the two jaws when set to 0 or brought together, being known, the additional distance represents opening of the jaws or the amount of flat that will be given the tool when ground to fit the gage. The gage is of course also applicable to "Acme standard" tools for threading, these being the same angle as for worm threads, but of different widths at the ends, and so requiring merely different settings of the same gage.

A LATHE ATTACHMENT FOR MILLING, GEAR CUTTING, ETC.

The Seneca Falls Manufacturing Company, of Seneca Falls, N. Y., have brought out an attachment to their lathe which is shown in the accompaying engraving and which seems well adapted for the amateur's shop and especially to the shop of limited facilities. The attachment consists of two parts, one of which is attached to the carriage and drives a cutter arbor placed at any angle, as indicated, while the other clamps to the bed of the lathe and holds the work at any elevation and either upon the centers as the tap is shown or placed upon an arbor fitted to the spindle, as in the case of spur or bevel gears. This attachment enables the owner of an ordinary lathe to groove taps, cut straight or bevel gears, groove reamers or do any work of such nature with the regular automatic feed of the lathe, there being a regular indexing device, as shown, for spacing. Any mechanic will readily see how the device is adapted to the various kinds of work mentioned and it is also adapted to receiving a vise for holding work to be milled.



LATHE ATTACHMENT FOR MILLING, ETC.

Personal.

H. E. Greenwood, manager of Newark Works, Westinghouse Electric & Manufacturing Company, resigned February 1.

Orange E. McMeans has resigned the position of mechanical engineer with the Richmond City Mill Works, Richmond, Ind., to accept that of milling engineer with the Nordyke & Marmon Company, Indianapolis, Ind.

Jos. R. Hanthorn, who has just resigned his position as superintendent of Bement, Miles & Co., Philadelphia, has accepted a position as general superintendent with the firm of Wm. Sellers & Co., taking effect February 1. As a token of appreciation a banquet was given as an "affaire d'honneur," January 31, at Curtell's Café. The office officials and the principal foremen made up the company of those present.

Obituary.

The death of Samuel Dixon, of Manchester, England, is announced. Mr. Dixon was a member of the firm of Kendall & Gent, whose shops and some of whose machine tools we have illustrated and described. He was the engineer member of the firm and a man of exceptional ability.

James Spear, a well-known inventor of stoves and heating apparatus, died in Philadelphia, January 30, seventy-four years old. Mr. Spear was a native of Pennsylvania and went into the employment of a stove-dealing firm in Philadelphia when about twenty-one, in a few years becoming the owner of the business. Mr. Spear made the first successful railway car heater, an anti-clinker grate widely used, a cooking range and several others in the same line.

Commercial Review.

NEW YORK, Monday, Feb. 3.

VARIOUS MACHINERY NOTES.

One of our local tool houses reports that among a number of good-sized orders closed recently one was for printing-press work, one for electrical and another for a shop on the Pacific Coast. This house has been especially fortunate of late in the sales of a make of screw machines which it handles.

Bids have been taken and awards are now awaited on the generator and engine equipments of two important buildings in this city. One of them is the new Stock Exchange, whose plant will have a capacity of 650 kilowatts, and the other is the new Astor hotel, which calls for 600 kilowatts.

The Crocker-Wheeler Company has received a contract to furnish the generators for the new Hall of Records in New York city. There are to be installed two 150

and one 100 kilowatt units to make 100 revolutions a minute; one 50-kilowatt machine at 265 revolutions, and a large booster. The company has also closed with the Henry Lang Company, a large tannery in Newark, N. J., to furnish two 75-kilowatt generators and 180 horse-power in motors. The company's business since the first of the year, so far at least as has come through its New York office, is pronounced exceptionally goo', being almost, if not quite, the best on record.

Sellers of electrical machinery state that the decline in copper has not been reflected in the prices of dynamos and motors. The copper that is being used now was contracted for some time ago at higher prices. Moreover, the slump in its extreme stages has proved a transient affair.

We have received information from the Buffalo Forge Company that it is planning to erect an entirely new plant, for its present facilities, occupying an entire block of five and six-story buildings with many adjacent structures, are far inadequate.

When an excessive demand for machinery arises one of the chief sources of embarrassment in filling orders is through the difficulty in obtaining castings. Such a state of affairs is now prevailing to some extent, as we have already noted. Many machine shops are dependent on outside foundries for their castings, and whether the latter have not a capacity corresponding to that of their customers, or whether foundries have an inordinate tendency to become congested with work or whether the trouble is due to the fact that the shops must have their castings in a hurry, even when deliveries on finished machinery are running several months behind, the fact remains that larger public foundry facilities would sometimes be a great boon. It is therefore interesting to note that F. E. Reed, Worcester, Mass., has awarded the contract to build on Gold street in that city a new foundry, where it is intended to produce high-grade machine-tool castings for the F. E. Reed Company and others. The main building will be 202x90 feet, of steel, brick and glass, in addition to which there will be an office, pattern and flask buildings. The equipment will embrace all modern improvements.

The Standard Steel Car Company, Pittsburgh, Pa., has contracted for the greater portion of the machinery to equip its plant. The total amount of the contracts so far awarded reaches $500,000. Plans for the car shops have been completed and it is thought that they will be located at Alliquippa. The location has not been officially announced, but it is said that the new plant will adjoin the proposed steel car wheel plant in which C. M. Schwab and C. T. Schoen are interested. The machinery ordered for the new plant provides for a capacity of 50 steel cars a day. Three presses, varying in capacity from 200 to 1,000 tons, will be built by Mackintosh, Hemphill & Co., of Pittsburgh. The necessary punches and shears will come from Hilles & Jones Company, of Wilmington, Del., and the riveters will be made by the Chambersburg Engineering Company. Electrical apparatus will be made by the Westinghouse Electric and Manufacturing Company. The machine tool equipment amounting to $250,000 is reported to have gone to a New York selling firm. It is expected to have the plant ready for operation by July 15.

We have received a report from Pittsburgh to the effect that the Braddock (Pa.) Machine & Mfg. Co.'s plant has been sold to the Carnegie interests and that it is thought this transaction means that the Carnegie people will use the works to manufacture rolling-mill machinery for their own use.

Referring to last week's editorial in which the harmonizing of the Allis-Chalmers Company with the United States Steel Corporation was mentioned, and in which it was suggested that the machinery made by Allis-Chalmers Company might be utilized in the legitimate operations of the steel company, this Braddock Company purchase takes on a greater significance as furnishing another indication that the policy of the steel trust is to place itself in an independent position regarding all lines of supply required to carry on its operations.

OPENING FOR CORK-CUTTING MACHINERY IN SPAIN—JAPANESE-BUILT LOCOMOTIVE.

The cork-stopper output of the Province of Gerona is synonymous with the collective Catalonian cork output since the Catalonian cork industry is limited to the Province of Gerona. This industry takes by far the first rank among those of that province, and it is asserted that the majority of the population is employed in making cork stoppers. This is done partly by the old hand method and partly by machinery, which is growing in use. The increase of the latter method indicates a need for hand-driven machines for planing, cutting into strips, cutting transversely, etc. Of late there are required also increasing numbers of machines for emery-polishing the stoppers which in great part come from Germany. It is understood that the parties employing these machines depend chiefly upon Spanish manufacturers for the emery paper to be used with them. The planing machines are run by hand, while for the remaining machines gas motors and, in a few factories, German or English steam engines are employed. The knives for the hand work as well as for the planing machines are principally of French manufacture. In spite of the fact that the German knife manufacturers of the Solinger district have of late tried hard to naturalize their products, their endeavors appear to have been hitherto unsuccessful, since French knives are still generally met with. The facts here stated are derived from the *Deutsche Industrie-Zeitung*, of Berlin.

The Company for the Manufacture of Railway Material in Osaka, Japan, has recently turned to locomotive building. Last October, according to a German paper, their first locomotive was ordered (or received) by representatives of the railway management of the Island of Formosa. The weight of this locomotive is somewhat over 31 tons; its speed 30 miles an hour. It is claimed to be 10 per cent. cheaper than an imported locomotive. The durability of the Japanese product remains, however, to be proven by experience. Both in the peculiarity of construction and the selection of materials it is attempted to secure the highest possible durability.

CHICAGO HOUSE-WRECKING COMPANY.

The Chicago House-Wrecking Company is erecting a machine shop and boiler house on its property at Thirty-fifth and Iron streets, Chicago. The principal building will be 560x135 feet and 60 feet high. The cost will be $60,000. In response to some inquiries made in connection with this piece of news the company furnishes the following information:

"This company was originally organized for the purpose of dismantling expositions and large institutions. We found that in connection with this undertaking we are put in possession of an enormous quantity of machinery, as a result of which we have devoted a considerable share of our energy to the purchasing and selling of boilers, engines and machinery in general. We have found it expedient to erect what will be the largest machinery building in the country, as far as we know of. We will keep it filled with the latest appliances in the line of traveling cranes and other apparatus for expeditiously handling large machinery. It will be modern in every way. We employ some one hundred hands in our repairing department. We are just now preparing to dismantle the Pan-American Exposition and will bring the major portion of the machinery to our Chicago plant.

"We are also engaged in removing from the plant of Armour & Co., of Chicago, 775 tons of refrigerating machines that they have sold to us owing to a change in their refrigerating methods. We are also dismantling the Lake Shore & Michigan Southern Depot of Chicago. We are interested in the dismantling of the Cleveland Post Office and Case Building. We have in stock something like 250 boilers, 300 engines and thousands of other machinery items."

CHICAGO MACHINERY MARKET.

Both in business actually placed and in inquiries still pending January has made a new record in the West in the electrical machinery trade. To illustrate: The Chicago office of the C. & C. Electric Company has had this year the best January trade in its history. Though little is expected this month by way of new business,

the latter was ahead of that for the average month of the year. A similar condition is reported at the Chicago office of the Bullock Electric Manufacturing Company. The Northern Electric Manufacturing Company has had a splendid trade, notable for the steady orders from old customers. The representative of one manufacturer says he has propositions out aggregating over $300,000, and that he has inquiries on his desk for as much more, that must be submitted during the next three or four days. Much of the work is large, including some street railway projects. Much of it arises from time to time quite unexpectedly, though a number of inquiries can be seen coming some time in advance. Two street railway projects, not yet financed, have been temporarily "hung up" since the little upheaval down at Cleveland, Ohio, but there is much business of the kind actually under way.

There is some cheapening of machinery, occasioned chiefly by the fall in the price of copper. Another possible factor is the increased capacities of the manufacturing plants. The representative of one large electrical machinery builder, who has lately completed a 50 per cent. addition to his plant, says the output of the plant has increased 100 per cent. These builders, as a rule, are adopting the most modern shop practice. It is related that the president of one company, returning from Europe, saw two large machine tools detached lying in the shop. Inquiring why those machines had been bought, he was told they were not bought but had just been discarded, though almost new. The superintendent of this shop watched the operation of every machine and knew its capabilities. He also knew of everything new that came out, and made immediate changes when better work of the new tool was demonstrated. This increased capacity serves the present market in good stead, else demand could not be met.

The Crocker-Wheeler Company has sold another 400-kilowatt generator for the new Lake Shore shops at Collinwood, Ohio; three 125-kilowatt generators to the St. Louis "Post-Dispatch"; a 200-kilowatt generator and 300 horse-power in motors to the Iola (Kan.) Portland Cement Company; four sets, each consisting of one 150- and one 120-kilowatt generators, to the Kilby Manufacturing Company, Cleveland, Ohio, for four new sugar plants, to be erected, two in Michigan, one in Colorado and one in Ontario.

The Bullock Electric Manufacturing Company has sold to the Allis-Chalmers Company for installation in the new Milwaukee shops, motors to be operated on the multiple voltage system, aggregating 2,000 ultimate horse-power.

Bion J. Arnold of this city will have charge, as electric railway engineer, of the New York Central's proposed underground work in New York.

Quotations.

NEW YORK, Monday, February 3.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$17 15 @ $17 65
No. 2 X	16 65 @ 17 15
No. 2 plain	16 15 @ 16 65
Gray forge	15 25 @ 15 75

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 16 50
No. 2 foundry, or soft	15 75 @ 16 00
No. 3 foundry	15 25 @ 15 50
Foundry forge, or No. 4	14 75 @ 15 00

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.73c. in carload lots. Smaller quantities from store, 1.95 @ 2.00c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—1.95 @ 2.00c. from store.

Cold Rolled Steel Shafting—Base sizes—From store, 2¼ @ 2½c.

Copper—Lake ingot, 13¾ @ 14c.; electrolytic, 13½ @ 13¾c.

Pig Tin—In 5-and 10-ton lots, f. o. b., New York, about 24½c.

Pig Lead—For wholesale lots, 4.10c., with .02½ @ .05c. extra for carloads.

Spelter—4.25c. for ordinary quality, New York delivery.

Antimony—Cookson's, in single cask lots, 10¼ @ 10½c., though in 15-cask lots it is quoted as low as 10c.; Hallett's, 8⅛ @ 8¼c.; Italian, 7¾ @ 7⅞c.

Lard Oil—Prime City, 78 @ 81c. in wholesale lots.

Manufacturers.

The Van Buren (Me.) Lumber Company proposes to build a mill in the spring.

The Peninsular Portland Cement Company, Jackson, Mich., proposes to double its capacity.

Robert Beutel, Bay City, Mich., will erect a sawmill and make additions to his woodenware plant.

The Eagle Lock Company, Terryville, Conn., will build an additional factory, 60x260 feet, four stories.

The contract has been let for a new building of the Whitman Mills, cotton goods, New Bedford, Mass.

Fire has destroyed the oil mill, ginnery and boiler-rooms of the Valdosta Guano Company, Valdosta, Ga.

Joseph Stewart, boatbuilder, New Castle, Del., proposes to improve his plant and install new machinery.

The F. R. Patch Manufacturing Company, machinists, Rutland, Vt., are building an addition to their foundry.

The Florence (Mass.) Manufacturing Company, brush manufacturer, is to put up two new buildings the coming season.

W. H. Dustin, of the Eagle Cotton Mills, Lawrenceburg, Tenn., proposes to form a stock company and rebuild them.

William F. Remppis & Co., manufacturers of wrought-iron railings, Reading, Pa., have taken out a permit for an iron addition, 28x68 feet.

The W. H. Page Boiler Company, Norwich, Conn., contemplates the erection of an addition to its plant. New machinery will be installed.

The cotton mills of the Ettrick Manufacturing Company, near Petersburg, Va., will be enlarged and improved at a cost of about $50,000.

The Marion Machine & Tool Company has selected a site at Upper Sandusky, O., and will erect five brick buildings. L. C. Cole is president.

A fire has occurred at the plant, at Milton, N. H., of the Milton Leatherboard Company, Boston, Mass. It is thought that the plant will be rebuilt.

It is understood that a new factory building is being erected by John H. Lyons & Sons, Syracuse, N. Y., who have a planing mill and box manufactory.

The trustees of Noble Hospital, Westfield, Mass., have voted to ask E. C. & G. C. Gardner to prepare plans and specifications for a boiler-house, 50x27 feet.

The A. Garrison Foundry Company, Pittsburgh, Pa., has decided to double its capacity. The plant has now in operation eighty molds and as many more are to be added.

Plans are being prepared for a boiler and power-house on the meadows of the Passaic River, N. J., for the Arlington Company, manufacturer of pyraline, New York city.

The Machias (Me.) Lumber Company (headquarters at Boston, Mass.) quite strongly contemplates building a new steam mill with band sawing, shingle and lath machinery.

Building contracts have been awarded for an additional manufacturing and warehouse building for the Detroit (Mich.) Stove Works. There will be a freight elevator operated by electric power.

Estimates were recently taken by Contractors Roydhouse, Arey & Co., Philadelphia, Pa., for a boiler-house and power plant, to be built at the Renova shops of the Pennsylvania Railroad.

F. I. Nichols, Grand Rapids, Mich., will establish a new maple flooring plant. He will at once build a brick factory, 50x100 feet, two stories; an engine and boiler house and two dry kilns.

A manufacturing building is being erected in Detroit, Mich., for the Boydell Brothers White Lead & Color Company. Space and power will be furnished as may be required for manufacturers.

The Warren City Boiler Works, at Warren, O., have secured the contract for the construction of storage tanks, conduits and galleries of the new plant of the Toledo Salvage Company in East Toledo.

The International Gas Engine Company, of 26 Broadway, New York city, with works at Mariners' Harbor, Staten Island, N. Y., has about completed arrangements for the construction of an addition to its plant.

Evansville (Ind.) men have formed a company to erect a powder and dynamite mill in Pike County. The name is the "Southern Indiana Powder Company." The capital stock is $50,000. Jabez Woolley, Jr., is president and George W. Hardy secretary and treasurer.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.
Punches & dies. Wal.M.Wks.,Waltham,Mass.
Stamping dies. Emmons Collins, Chicago.
Caliper cat. free. E. G. Smith, Columbia, Pa.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Will pay for "American Machinist" Index, year 1896. Address Box 127, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Old style screw planer, not less than 42 inches wide. The Highland Machine Co., Boston, Mass.

Shafting straighteners; also volumes and odd numbers "American Machinist," 20 years. J. H. Wells, Tampa, Fla.

Wanted—Second-hand Peck lifter, to lift 800 lbs.; state cash price and condition. C. Cowles & Co., New Haven, Conn.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Wanted—1½ or 2 horse-power oil or gas engine in first-class condition. Send description and price to C. Stoeter, 266 6th ave., Long Island City, N. Y.

For Sale—Patterns and drawings for a line of wood-working machinery, up to date; trade established; demand good; use of name if desired; rare opportunity for good business. Box 128, AMERICAN MACHINIST.

Purchaser for small manufacturing plant; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

A thorough machinist, with good shop located in southwestern Ohio, would like to correspond with the object of making permanent contract to build medium-weight machinery; those having established trade preferred. Address Box 117, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Up-to-date foreman patternmaker open for engagement. Box 125, AMER. MACHINIST.

Millwright, 25, wishes position; first-class reference. Box 123, AMERICAN MACHINIST.

General machine shop foreman; thoroughly practical man; first-class references. Box 136, AMERICAN MACHINIST.

Mechanical engineer, Swedish graduate, 3 years' experience, wants position. Box 126, AMERICAN MACHINIST.

Machine, tool and fixture designer, shop experience, wants position as assistant superintendent. Box 129, AMERICAN MACHINIST.

Mechanical draftsman, tool and machine designer, shop experience, automatic machinery preferred, open for position. Box 130, AMERICAN MACHINIST.

A hustling factory superintendent, 37, solicits correspondence; duplicate machines, watch and clock work, punches and dies. Box 140, AMERICAN MACHINIST.

A practical superintendent or general foreman of 20 years' experience on high-speed and Corliss engine and mill work. Address R. J. S., care AMERICAN MACHINIST.

Foreman patternmaker wants a position; middle age; experienced on both wood and metal; highest reference and reasonable salary. Box 138, AMERICAN MACHINIST.

Head draftsman, 6 years' experience in textile work and power transmission, wishes position as assistant superintendent; references. Box 103, AMERICAN MACHINIST.

Position wanted as foundry foreman; experienced on machinery, furnace and molding machines; 8 years as foreman; 17 years in the business. Box 124, AMERICAN MACHINIST.

Foreman patternmaker wishes position; experienced in marine, mining, sugar mill machinery, Corliss engines; college educated. Address "Skeleton Pattern," care AM. MACH.

Practical machine designer, technical graduate with shop knowledge, 10 years' experience intricate automatic machinery and tools, light and heavy, wishes to change. Box 51, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, desires responsible position with progressive concern; 4 years' experience, shop, power, plants, conveying and elevating machinery. Address Box 122, AMERICAN MACHINIST.

Chicago manufacturers.—A thoroughly practical toolmaker, Eastern man, age 37, wishes position as foreman of manufacturing department; references from past and present employers. Box 139, AMERICAN MACHINIST.

Bookkeeper, aged 30, single; thoroughly experienced in manufacturing line; up to date methods; all-round man; capable of taking charge of office; exceptional references; salary required $20 per week; vicinity of New York preferred. Box 137, AMER. MACH.

Electrical engineer, technical graduate, with 7 years' experience developing, installing and operating steam and electrical machinery, seeks change on February 15th; expert on electrical design and invention. P. O. Box 205, Brooklyn.

Experienced draftsman, technical graduate of Germany, with 5 years' experience, of which 3 years as designing draftsman with leading tool-building concern, wishes to change present position; speaks and writes four languages; best references. Box 141, AMERICAN MACHINIST.

Mechanical engineer, technical graduate; 5 years' shop experience; 5 years' experience in design of Corliss engines, compressors, pumps, motors and special shop equipment; at present mechanical engineer; want position as superintendent or mechanical engineer. Box 135, AMERICAN MACHINIST.

Help Wanted.

Wanted—First-class tool and die makers. Address Box 99, AMERICAN MACHINIST.

Wanted—Two experienced patternmakers for Colorado; wages 30 cents per hour. Address Box 105, AMERICAN MACHINIST.

Wanted—Working foreman toolmaker accustomed to screw machine tools. Address "Automatics," care AMERICAN MACHINIST.

Three machine tool foremen, two erection foremen and two inspectors used to heavy machine work. Box 115, AMER. MACHINIST.

Wanted—In Pittsburgh, a good mechanical and structural draftsman; write, stating age, experience and salary expected. Box 133, A. M.

Wanted—10 thoroughly experienced mechanical draftsmen on hoisting and conveying machinery. Address Box 120, AM. MACH.

Wanted—A few first-class toolmakers on tools and fixtures; capable men only. Address The Blickensderfer Mfg. Co., Stamford, Conn.

Wanted—Number of patternmakers, experienced on compressor or steam engine work; none others need apply. Franklin Air Compressor Co., Franklin, Pa.

Wanted—Five experienced machinists for Colorado, to run tools, boring mill, planer and lathes; wages 30 cents per hour. Address Box 106, AMERICAN MACHINIST.

Wanted—A first-class toolmaker, experienced in making cutters for gears preferred; also one gear cutting man for office and shop. Address Boston Gear Works, Boston, Mass.

Wanted—Experienced man as foreman, shop working on reproduction of brass, steel, iron and malleable parts; state experience, salary, etc. Address B. C., care AM. MACH.

Wanted—A first-class machine tool designer, one accustomed to small and medium machine tools and having had experience on high-grade work. Address L., care AM. M.

A firm located about 100 miles from New York, desires to secure the services of a competent mechanical draftsman; applicants will please give full particulars. Box 98, AM. M.

Wanted—Competent general draftsman. Apply by letter to Eastman Kodak Company, Rochester, N. Y., and state age, experience and salary expected, and give names of former employers.

Wanted—A draftsman familiar with turret machine practice; capable of designing tools for cast iron work; shop located in a small N. E. town; permanent position. Box 97, AMERICAN MACHINIST.

Wanted—Draftsman, about 30 years of age, with technical education and experience in Corliss and general steam engine work; state experience and salary expected. Box 132, AMERICAN MACHINIST.

Wanted—Mechanical draftsman with first-class experience on general machinery, preferably in steel works; state age, experience, reference and salary expected. Address P. O. Box 1042, Philadelphia, Pa.

Wanted—First-class machine shop foreman for New England shop employing 30 men; work is general transmission of power machinery and repairing; only experienced men need apply. Address W., care AM. M.

Wanted—Experienced toolmaker; one who has had experience on brass work and, if necessary, is capable of acting as foreman of shop employing 30 men; state experience, salary, etc. Address A. H., care AM. MACH.

Wanted—A good machinist who can take charge of machine shop in a bridge works and who understands electrical repair work. Address "A.," care AMERICAN MACHINIST, giving experience, recommendations and wages expected.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Shop agents everywhere to introduce a line of high-class machinists' tools, indispensable to every mechanic; an easy way for the right person to make money; full particulars on application. Massachusetts Tool Co., Greenfield, Mass.

Draftsman wanted; must be competent to take charge of drawing room in small shop, and must be familiar with modern shop methods; a permanent position for the right man. Address, giving full particulars, Box 121, AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman for brass foundry, experienced in making brass valves and fittings, familiar with molding machinery and mixing of metals; state age, experience, salary expected and references. Box 104, AMERICAN MACHINIST.

Wanted—Foreman and layer-out in a contract boiler shop employing 25 men; capable of laying out all kinds of boiler and tank work and experienced in handling men; give age, experience and wages wanted. Address "Cincinnati Boiler Maker," care AM. MACH.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 28, AMER. MACH.

Wanted—First-class designing draftsman, with shop experience preferably, on pump and hydraulic work; must give unquestionable references as to ability and be thoroughly reliable as a mechanic and otherwise; permanent position to satisfactory man; state salary required. Box 134, AMER. MACH.

Wanted—One experienced, up-to-date factory bookkeeper in shop building steam engines and boilers, etc.; give full information as to experience in the details of manufacturing and costs of same; entire new shops in Western Pennsylvania. Address, stating salary expected, Box 131, AMER. MACHINIST.

A machine tool-building concern near Manchester, England, wants a man with experience in machine tool construction to act as inspector, to inspect the work as it goes through the shop and also the machines when finished; shop is of modern construction and doing high-grade work. Address Box 100, AMERICAN MACHINIST.

We are erecting new shop buildings and equipping same with all modern appliances; will shortly require an increased number of skilled mechanics; we invite application from machinists, boilermakers and patternmakers; good references must be furnished as to ability and habits. Address Southern Engine & Boiler Works, Jackson, Tenn.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

Special Stockholders' Meeting.

Notice is hereby given that a special meeting of the stockholders of the AMERICAN MACHINIST PRESS will be held at the office of the company at No. 218 William street, in the Borough of Manhattan, city of New York, at twelve o'clock noon on Monday, February 17, 1902, for the purpose of voting upon the proposed sale of the property, rights, privileges and franchises of the AMERICAN MACHINIST PRESS to the Hill Publishing Company.

A. LEIGHTON DONNELL, Secretary.

New York, February 1, 1902.

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Babbitt Metal
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Niles Tool Works, New York.

Drills, Ratchet
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Troy File Works, Troy, N. Y.

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The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

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Wright Mfg. Co., Detroit, Mich.

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Billings & Spencer Co., Hartford, Conn.
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Wyman & Gordon, Worcester, Mass.

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Obermayer Co., S., Cincinnati, O.
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Whiting Foundry Equip. Co., Harvey, Ill.

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Am. Gas Furnace Co., N. Y. City.
Chicago Flex. Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

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Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Ct.
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Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

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Crosby Steam Gage & Valve Co., Boston, Mass.

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Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
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Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Turley, J. G., St. Louis, Mo.

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Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

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New Process Raw Hide Co., Syracuse, N. Y.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinder, Cutter
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Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Norton Emery Wheel Co., Worcester, Mass.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Gorton Mach. Co., Geo., Racine, Wis.
Universal Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Anderson Tool Co., Anderson, Ind.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Anderson Tool Co., Anderson, Ind.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Universal Mach. Co., Provi., R. I.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
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Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

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Cleveland Stone Co., Cleveland, O.

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Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Ct.
Reed Co., F. E., Worcester, Mass.

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Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Perkins Mach. Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Ct.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Standard Pneumatic Tool Co., Aurora, Ill.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburgh Shear, Knife & Mach. Co., Pittsburgh, Pa.

Handles, Machine Tool
Norwood Bicycle Co., Cincin., O.
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., 23 John st., N. Y. City.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Standard Pneumatic Tool Co., Aurora, Ill.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Igniters, Gas Engine
Maxwell Engineering Co., Rome, N. Y.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Keuffel & Esser Co., New York.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Joints, Universal
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis, W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Standard Gage Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y.
Lea Elec. Mfg. Co., Anderson, Ind.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Ct.
Waltham Watch Tool Co., Springfield, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Schwickart, Ph., Brooklyn, N. Y.

Lathe Feed
Nat'l. Mach. Tool Co., Cincin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Baird Machy. Co., U., Pittsburgh, Pa.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis, W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Silk Mach. Co., P. P., Cincin., O.
Washburn Shops, Worcester, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Smith, E. G., Columbia, Pa.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Amer. Ordnance Co., Bridgeport, Conn.
Blanchard Mach. Co., The, Boston, Mass.
Fawcus Mach. Co., Pittsburgh, Pa.
Hardinge Bros., Chicago, Ill.
Watson Mach. Co., Paterson, N. J.

Machinists' Small Tools
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Ct.
Reichhelm & Co., E. P., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Wells Bros. Co., Greenfield, Mass.

Measuring Machines
Pratt & Whitney Co., Hartford, Ct.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Ct.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Ct.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Ct.
Garvin Mach. Co., New York.
Ingersoll Mill. Mch. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.
Quint, A. D., Hartford, Conn.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eddy Elec. Mfg. Co., Windsor, Ct.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Molds, Soft Hammer
Field, Chas. H., Providence, R. I.

Molds, Vise Jaw
Field, Chas. H., Providence, R. I.

Nut Tappers
See Bolt and Nut Machinery.

Oilers
Bay State Stamping Co., Worcester, Mass.

Oil Cups and Covers
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans and Tote Boxes, Steel
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyon Mfg. Co., Chicago, Ill.

Pans, Lathe
Lyon Mfg. Co., Chicago, Ill.
New Britain Mch. Co., New Britain, Conn.

Patent Solicitors
Anderson & Co., E. W., Washington, D. C.
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Copp & Co., Washington, D. C.
Cromwell, W. H., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.
Olmstead Co., H. B., New York.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe and Fittings
Crane Co., Chicago, Ill.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.

Planers—*Continued*
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works, New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Ct.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hand
Pratt & Whitney Co., Hartford, Conn.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Perkins Mach. Co., Boston, Mass.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Ct.

Pulley Covering
Warren Co., Chicago, Ill.

Pulleys
Howard Iron Works, Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mch. Co., Pittsburg, Pa.

Racks, Cut
Standard Gage Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Geometric Drill Co., Westville, Ct.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Wks., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather & Co., Nashua, N. H.

Recorders, Speed
Starrett Co., L. S., Athol, Mass.

Rheostats
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Standard Pneumatic Tool Co., Aurora, Ill.

Roller and Ball Bearings
Ball Bearing Co., Boston, Mass.
Roller Bearing & Equip. Co., Keene, N. H.

Rolling-Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Bowler & Co., Geo. H., Cleveland, Ohio.
Dawson, John H., Chicago, Ill.
Doan & Co., J. B., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works, New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
Amer. Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Springfield, Vt.

Separators, Steam
Austin Separator Co., Detroit, Mich.

Shafts, Flexible
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Shapers
Amer. Tool Works Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Co., Pawtucket, R. I.
Pratt & WhitneyCo., Hartford, Ct.
Steptoe & Co., John, Cincinnati, O.

Shapers, Vertical Die
Rochester Die Shaper Co., Rochester, N. Y.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., Boston, Mass.
Pittsburg Shear Knife & Mch. Co., Pittsburg, Pa.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mch. Co., Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Springs
Cleveland Wire Spring Co., Cleveland, O.
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Machinery
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., N. Y. City.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Quint, A. D., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Crane Co., Chicago, Ill.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.

Thread Cutting Tools
Hart Mfg. Co., The, Cleveland, O.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Wright Mfg. Co., Detroit, Mich.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Pawling & Harnischfeger, Milwaukee, Wis.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Trucks, Shop
Towsley Mfg. Co., J. T., Cin., O.

Turret Machines
Amer. Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works, New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Ct.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Syracuse Twist Drill Co., Syracuse, N. Y.

Valves
See Steam Fittings.

Vises, Metal Workers'
Fulton Mach. Co., Canal Fulton, Ohio.
Howard Iron Works, Buffalo, N. Y.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Wks., Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.

Vises, Wood Workers'
Wyman & Gordon, Worcester, Mass.

Washer and Tester, Boiler
Rue Mfg. Co., Philadelphia, Pa.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.

Worm Gearing
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.

Some Examples of Chain Drives.

Our readers are for the most part already familiar with the silent driving chain as designed and manufactured by Hans

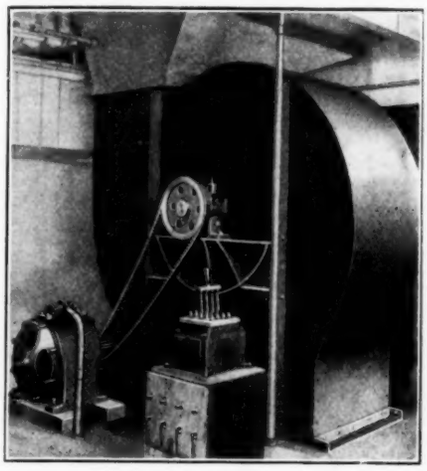


FIG. 1. FAN DRIVING.

Renold, of Manchester, England, as we have set forth its points of construction and of its adaptability to automatically compensate for lengthening caused by wear. We have also referred to the fact that the manufacture of this chain has been taken up in this country by the Link Belt Engineering Company, of Nicetown, Philadelphia, Pa., and we are glad to note that its introduction here is going on very rapidly, it proving to be exceptionally well adapted for many drives which for one reason or another have given trouble when attempted by other means.

At Fig. 1 we show the application of such a chain to transmission from a standard electric motor to a fan used at the works of the Natural Food Company, Niagara Falls. In this case it was desired to have something more reliable than a belt for transmission and at the same time absolutely quiet running was necessary. The use of the chain in such a drive enables any standard motor to be installed and it is simply a matter of fitting the required sprocket wheels to give the desired ratio of speeds. In this case the motor is of the Westinghouse induction type, 10 horse-power, running at 1,710 revolutions per minute.

Some time ago we and several correspondents had considerable to say about the driving of engine governors and we advocated some form of a positive drive for them, so that it would be reasonably certain that whenever the engine moved the governor would be sure to move at a corresponding rate of speed. Fig. 2 shows the application of the chain to such a drive on a 14½x24-inch Porter-Allen engine at the works of Jos. Bancroft Sons Company, Wilmington, Del. The distance between the crankshaft and the pulley governor is here very short and a belt by reason of the oil used upon the machinery and for other reasons is apt to be quite unreliable. The chain, however, gives an absolutely positive drive and at the same time there is no noise or any reasonable liability of stoppage of the governor so long as the engine continues to run. An engine of the same make, 24x30 inches, had previously been equipped in the same establishment.

Fig. 3 shows the application of such a chain to a curious purpose—that is, the driving of a merry-go-round which has been installed in the large department store of Hahne & Co., Newark, N. J. Gears had been at first used, but in the position they were in they made too much noise to be permissible and the silent chain took their place, in this case, for practically no

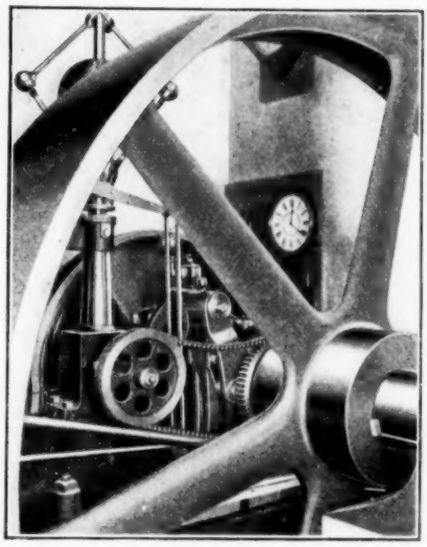


FIG. 2. DRIVING THE GOVERNOR OF A PORTER-ALLEN ENGINE.

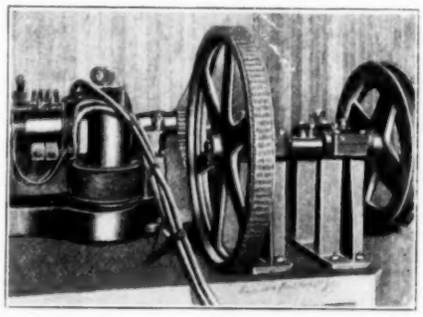


FIG. 3. DRIVING A MERRY-GO-ROUND IN A STORE.

other reason than the necessity of securing absolutely quiet running. This drive is notable for the large ratio of reduction as well as for short center distance.

Fig. 4 shows a drive from a standard motor to a line shaft in the shops of the Union Traction Company, in Philadelphia, where the center distance is quite short and where, as will be readily recognized, a belt would have been likely to be very unsatisfactory. Under such conditions, however, the chain referred to works perfectly and probably at least as well as under any other condition. This motor is General Electric 5 horse-power at 1,200 revolutions per minute.

Cutting Square Threaded Screws.

BY W. S. ROWELL.

The subject of square threaded screws has interested me more than a little, and I have felt since its introduction and analysis by Mr. De Leeuw that you should publish a different picture from the one that appears on page 1161, Vol. 24.

Throughout this article we will call the metal left between the grooves cut by the thread tool, the thread, and the groove will be called the thread groove or groove. While we are naming things we will christen the form of thread tool discussed in the article mentioned, the tool of equalized top rake, or balanced top rake—to make it shorter, balanced thread tool. We will call the tool that is fed to the work in the plane of centers, the level top tool.

Mr. Meyer makes a good point, at page 1275, when he refers to a thread tool as a forming tool. That is, it is a tool that produces the desired form more or less independent of machine feeds; depending more upon its own shape and position. In discussing the effect of balancing the top rake of a *square* thread tool by turning its top surface as nearly square across the thread groove as possible, it should be remembered that the same conditions would affect any other form of thread in a similar way.

It is my wish to take the case of a screw and nut of the dimensions given by Mr. De Leeuw (8 inches diameter, 12 inches lead, triple R. H. T.) and section it on three planes, noting the forms thus produced, both in the normal square thread and in the thread cut by the balanced tool. Nothing will be said about clearance for side of tool. We will consider form and position of *top* only.

Of course all threads must be measured and dimensioned in the plane of the axis; but the easiest way to learn the effect of balancing a thread tool is to section the screw and nut on the plane of tool top and note form of thread. Working on this line, I have made the accompanying drawings.

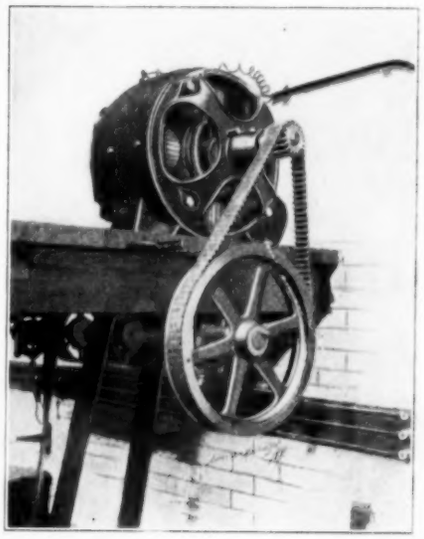
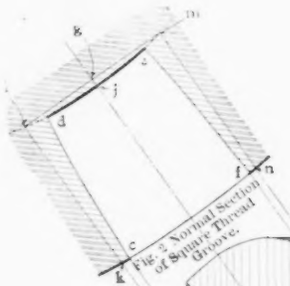


FIG. 4. A SHORT DRIVE TO A COUNTERSHAFT.



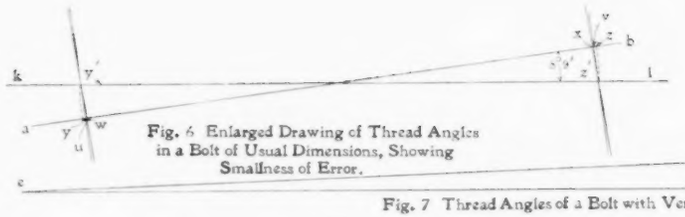


Fig. 6 Enlarged Drawing of Thread Angles in a Bolt of Usual Dimensions, Showing Smallness of Error.

Fig. 7 Thread Angles of a Bolt with Very Deep Thread.

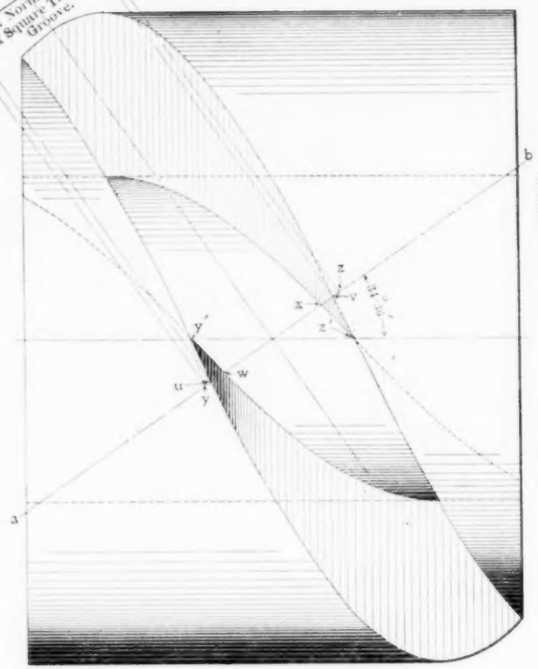


Fig 1 Side Elevation of Bolt with Square Thread Groove.

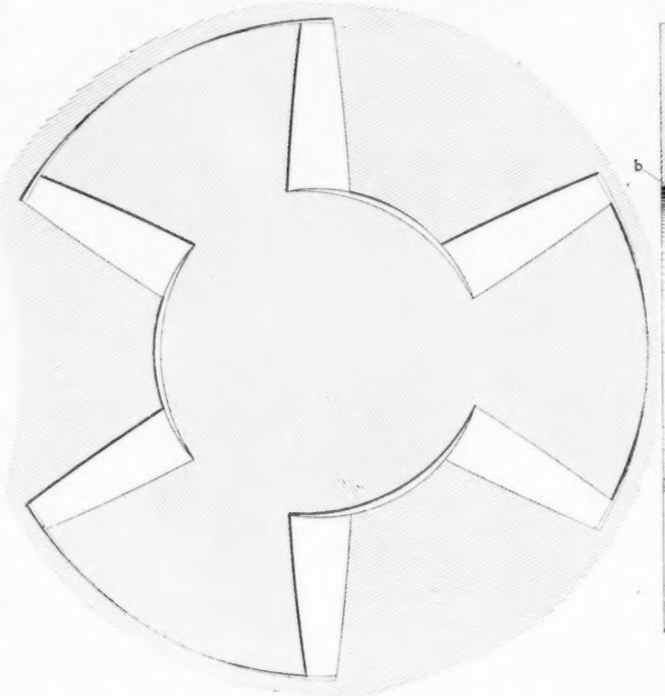


Fig. 5 Right Angle Cross Section of Bolt and Nut Cut with Tool No. 3.

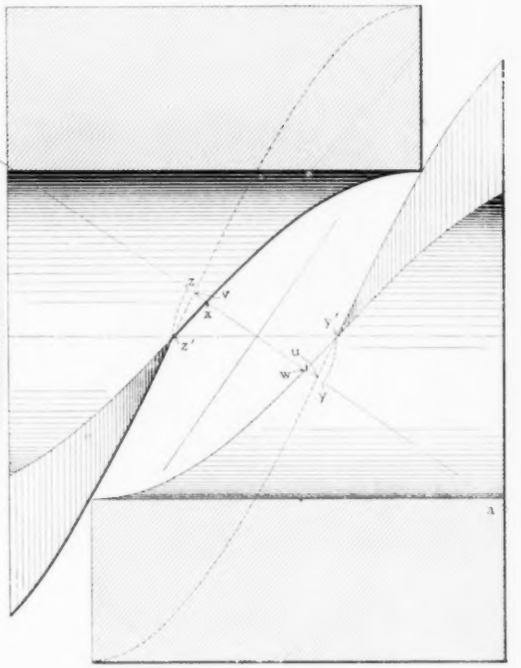


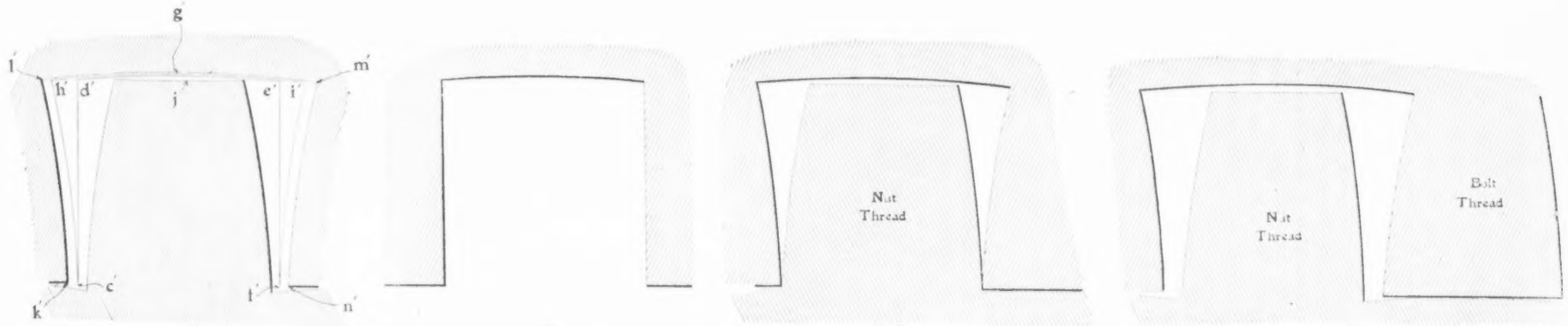
Fig 4 Section on Plane of Center Line of Normal Square Thread Nut or Hollow Bolt.

American Machinist

which, while not all that could be desired, will help in getting a clear mental picture of the thing done. But one groove is shown in the side view of the bolt, Fig. 1, and Fig. 4 may be called a section of a nut; but really is a section along the plane of centers of the same one thread bolt, with the core bored out. A little inspection will show that in square thread work there is no difference between the threads of a nut and the threads of a bolt, except that one is held in place by metal on the outside and the other by metal on the inside. In other words, if we were to bore out all the core of a square thread bolt and turn off all the metal from the outside of the threads of a mating nut, we would have duplicates, if we had taken a piece of bolt just as long as our nut is thick. Attention is called to this, and Fig. 4 is made as it is, that we may the easier see differences between the forms of threads produced in bolts and nuts by the balanced tool.

This form of tool is not at all rare, and it has been described in the AMERICAN MACHINIST several times. I believe Mr. C. W. Wright, now with the Westinghouse Machine Company, was one of the early contributors in that line, but it was left for Mr. De Leeuw to find its weak points. The balanced tool is used because of its superior cutting qualities and because the error it introduces is usually a negligible quantity and tends toward a loose fit.

It is quite easy to think of a case where balancing the top rake of a square thread tool by turning its top face square across the center line of thread would result—in the case of a bolt—in a thread groove, too narrow at the outside, too wide at the inside, and of normal width somewhere between, and—in case of a nut—a thread groove too wide at the inside of the nut, too narrow at the outside diameter of nut threads and of normal width somewhere between. Such a bolt and nut could not be screwed together, the interference would occur at the outside portions of threads.



A
Sectioned Outlines Show Bolt and Nut Threads Cut with Tool No 3. Other Outlines Show Nut Threads Cut with Tools Nos. 1 & 2.

B
Bolt Groove Cut with No. 1 Tool Nut Groove Cut with this Tool Nut Shown as Tool is Wholly Unfit for Cutting Nut.

C
Bolt Groove and Nut Thread Cut with Tool No. 2

D
Bolt and Nut Thread and Groove Cut with Tool No. 3.

FIG. 3. SECTIONS ON PLANE OF CENTER LINE OF BOLT AND NUT THREADS CUT WITH VARIOUS FORMS OF TOOL.

where, as the grooves are too narrow, the threads—metal left between the grooves—must be too wide and would interfere.

If anyone doubts this, let him come with me while we cut an unusual screw. That we may fully understand how this can be, let us look into the conditions that make a tool cut a wider or a narrower groove than the one we want. It is easy to see that any tool will cut its maximum width when square across the groove, and narrower as it is placed obliquely; and it goes without saying that if we measure the groove in the plane of the tool top it will measure the same as the tool. This is very plainly shown in Fig. 1. Here it is seen that in the plane of centers a tool $y'z'$ wide is necessary to cut the desired groove; but turn this same tool square across the same groove to the plane $a\,b$ and we see it is too wide. This is the key to all this peculiar action on the part of balanced thread tools. Now if we can think of a screw of such a diameter, lead and depth of thread that by balancing the top rake in the usual way we will be cutting the outside of the thread with the tool top more obliquely across the groove than the normal position, and the inside with the tool top more nearly square across the groove than the normal position, we will have the one where the outside will be cut narrower because of this obliquity and the inside wider because of less obliquity.

A screw 8 inches diameter, 1 inch lead, with a single square thread 3 inches deep, would be such a screw. By the method for finding thread angles so often and recently described in the AMERICAN MACHINIST we have Fig. 7, in which $a\,e$ represents the outside circumference, $a\,d$ the core circumference, $a\,c$ the lead, $c\,e$ the outside of thread and $c\,d$ the inside. Measured by a protractor, or a table of tangents, we find these angles to be: for line $c\,e$ (thread angle at outside of screw), 2° 17′, and for line $c\,d$ (thread angle at core) 9° 3′. By Fig 7 it will be seen that a tool fed to the work in plane of centers (line $a\,c$) would be nearly square across the groove at outside of screw, but would be 9° 3′ off when it reached the core. A level top tool ½ inch wide fed in plane $a\,c$ would cut this thread, but when we tip the right-hand side up and the left-hand side down (in order to balance the top rake) we will see the change in width of thread groove because of the change in obliquity of tool in groove. Plane $a\,c$, the plane of centers, is 2° 17′ off of square across outside of thread groove, but 9° 3′ off of square across groove at core, or inside. To balance the top rake in this case in the usual way will require that the tool top be 5° 40′ off the plane of centers. That is, 2° 17′ + 9° 3′ ÷ 2 (to get the average inclination) = 5° 40′. Here we see the balanced tool cutting part of the groove—the outside part—in a position *more* oblique than the level top tool would be so this part will be *narrower* than the level top tool would make; while the inside part of the thread will be cut by a tool nearer square across than the level top tool, and so will be wider than that tool would make. Again it is all a matter of the obliquity of the tool top in the thread groove that influences the width of this groove, the tool width remaining constant.

Following the same method we find—in the case given by Mr. De Leeuw—the top of balanced tool 34° 36′ off the plane at centers. Section the normal square groove on this plane and we find form $c\,d\,e\,f$, Fig. 2. It will be seen that a tool to cut this form—we will call it No. 1—when fed to work in plane $a\,b$ must have the outline $c\,d\,e\,f$ and be narower at the nose than at the portion that cuts the outside of the thread by as much as $w\,x$, Fig. 1, is less than $u\,v$, and it must be concave at the end to fit the long radius side of the ellipse developed by sectioning the core on plane $a\,b$. This is a true square when cut on plane of centers, as shown by $c'\,d'\,e'\,f'$, Fig. 3*A*. It will also be seen that the sides of tool No. 1 are not a straight taper but convex. Careful measurements show something like 1-64 inch convexity. I have never known of a tool being made in this way to cut a square thread. Mr. Myers had such a tool in mind when he suggested a tool something like the Acme. Another tool would be a parallel square-nose tool $u\,v$ wide, Fig. 1, fed in on plane $a\,b$ till corners touched core—we will number it 2—its groove sectioned in $a\,b$ would be similar to $k\,l\,m\,n$, Fig. 2, but not so wide by as much as $u\,v$ is less than $y\,z$. Sectioned in plane of centers it is $c'\,h\,i\,f'$, Fig. 3*A*. The outline $k\,l\,m\,n$, Fig. 2, is the section on plane $a\,b$ of the groove cut by a third tool, which is such a tool as Mr. De Leeuw tells us of using—namely, a full width level top square-nose tool turned square across the

groove and fed in till corners touched core. It will be seen that the bottom of groove is concave ($g\,j$, Fig. 2; $g'\,j'$, Fig. 3A), and by sectioning this groove on plane of centers we have outline $k'\,l'\,m'\,n'$, Fig. 3A. A frightful form it is, but no more so than would be developed in nut groove if it were cut in the same way with No. 3 tool ($y'\,z'$, Fig. 1, and Fig. 4) turned to plane $a\,b$ and fed till full depth of groove is reached by all parts of tool nose. As the nut grove must be cut from the inside, it will be convex at the bottom. In the case of a nut, tool-corners will touch work first, unless the tool has been rounded on the nose, and so the groove will remain deepest at the corners (see Fig. 3A for section on plane of centers of nut thread cut by tool No 3). As our bolt groove cut by No. 3 was too wide nearest the core, our nut groove cut by the same tool will be the same way, too wide near core, or *bore*, and we have a very open groove. In the nut, as in the bolt, the portion of groove nearest the large diameter will be as much wider than normal as $y\,z$ is greater than $u\,v$, and the portion nearest the small diameter as much wider than normal as $y\,z$ is greater than $w\,x$. This excess of groove width in both bolt and nut results in a very loose fit. The section lined portions of Fig. 3A show bolt and nut cut with tool No. 3 in plane of centers. Fig. 5 is an end view of the De Leeuw triple thread screw and nut cut the same. That no one need hesitate about using a balanced tool for almost any job of thread cutting, I give in Fig. 6 a drawing of the angles, etc., of a screw 1¼ inches diameter, ¼ inch pitch, ½ inch lead, double right-hand square thread, drawn on an enlarged scale (100 to 1 in the original) wherein $k\,l$ is the center line, $a\,b$ the tool top and other parts are lettered uniformly with Fig. 1. A No. 3 tool used on this screw in plane $a\,b$ would result in a groove about .001 inch wider than normal and undercut less than half that amount.

From all this it will be seen that when such a screw as Mr. De Leeuw had in hand is to be cut it is a case of cut it some other way, but that the balanced tool may be used safely in most cases. The matter of a concave bottom to the bolt groove is seldom or never harmful, and the convex bottom of the nut groove is easily remedied by rounding tool nose slightly.

Echoes From the Oil Country.

PRINTING PRESS WORK.

I was only an ordinary machinist. I went where I was told to and believed in doing the best I knew how. I was not responsible in any way for the man who had been up to the printing office and torn down their press and moved it to its new quarters. If he did drink whiskey it surely did not make his breath smell any worse than that of the man that walked by me and loaded me and the shop and mechanics in general with all sorts of abuse as we went toward his office to find out what was the trouble.

I was old enough so that such talk did not mean much unless it carried some information that was of use. I had often heard it when I had to go out on someone else's job, and so had learned to wait until I had a good chance before I hit back. I am not exactly laid out for a pugilist, and a good thumping would be about the gentlest means that would steady up some men when their stuff begins to show the "perversity of inanimate things."

I reached the office without any knowledge of what was wrong, except that the press was liable to fall to pieces, and that the firm was liable to not get any pay for the job, and would have a law suit on their hands and get a blowing up in the paper, while, if I was as "dumb" as the fellow who had done the job, I was lucky if I got off with a whole hide; indeed, it was hinted that it might be necessary to follow me back and clean out the whole shop.

One revolution of the press showed the trouble, and I was surprised that they did not see it. The man who did the job told me the owner had stood around and growled so much about how slow he was working that he had hurried all he could to get out and had tried it before putting on the inking rollers, but not afterward. In putting on the distributing roller he had set it to one side, so that it ran too far sideways, striking the side of the press and springing the sides apart badly.

For the information of those who are not acquainted with the country newspaper press I will explain how this roller worked. It is a long roller, made of some peculiar composition, and reaches across the table of the press, having a bearing on each end. One of the bearings is just a plain cylindrical one, while the other one is threaded, the thread being quite coarse and fitting into a flanged nut which is held on to the frame on that side by screws. This roller bears on the inking part of the table that travels back and forth, and of course it moves sideways as it is revolved by the table traveling under it. The man who had set up the press had not screwed the nut to the proper place before fastening it.

As soon as I saw the trouble I asked for a screwdriver, and the boy that ran the press and the owner both began hunting for one, the owner still swearing. They did not seem to know just where to look for it, and as I was used to using all sorts of make-shift tools I picked up an old hatchet lying near and tried one of the screws and found that it started readily; so I quickly took them out, gave the nut a twist to where I thought would be about right and put in the screws again. I then dropped the hatchet and went nosing around the press, as I saw they had not noticed what I had done, and I was ready to try to "get back" at my tormentor.

When he got around with the screwdriver I opened up. "Say; see here now; I've been looking this thing over and I don't see anything very much the matter with it. Start her up and let me see what you're doing all this growling about, anyway."

He glared at me and growled out: "You're as dumb as the rest of the dumbed lot. Didn't you see that thing flop around when we started before? I tell you if it falls to pieces you will have to pay for it. I'm not going to pay a lot of ignorant jackasses for smashing up my press; you just mind that, and if this thing isn't going pretty quick your company will have damages to pay. Why in thunder don't they have some decent men working for them, instead of a lot of ignoramuses, I'd like to know?"

I took a look at that roller, to be sure of its position, and nodded to the boy, with "Let her go." He let her go, and it ran as smoothly as could be desired, while I went over it carefully, making a few adjustments and seeing that everything was tight and setting the screws in the nut up hard with the screwdriver, without giving any hint of what I had done, while the owner stood around with a puzzled expression, muttering softly to himself.

"Now, where is that awful job you have been telling me so much about. I have looked her all over and don't find anything wrong, and I don't believe you ever had your old junk pile running any better than it is. Because your old rattle-trap of a building shakes when a train goes by, you shouldn't get rattled and come rushing down to the shop and act like an idiot, and, besides, good men come high and I can't be coming up here for nothing."

"Well, by jimminy, young fellow, if I hadn't been in the room all the time I would swear you had done something to that press, although I don't believe you have brains enough to fix anything; but you haven't had a chance to do anything if you could. Why, confound you, I was afraid the thing would fall to pieces before we could stop it when we tried to run it before I went down to the shop," and he stood wiping his forehead and staring at the press.

"Oh, you get out," I replied, giving the boy (who had sided up to me with "Say, Mister, there was something pretty bad wrong; didn't you notice it when we started up after you came in?") a nudge and a wink. "You'd better swear off and brace up, or you'll be seeing snakes and imagine your whole printing office is hopping around. There's no use of me wasting any time here, so good day," and I started for the door, leaving him too dazed to give any reply, and still looking at the press as though he expected to see it begin to cut up at any minute.

I hoped I had impressed him with a sense of the dignity and importance of the machinist trade. The boy followed me out and wanted to know how it came that that press behaved as it did. "There was something wrong, just as sure as you live," he

said, confidentially like; "why, the sides went in and out just like breathing, you know; and you just ought to have heard him swear before he started for the shop."

As the boy seemed a straight, nice sort of a fellow, trying to do the b st he could, I told him where the trouble had been and what I had done. I also told him not to tell the owner unless he cooled down and acted at least civilized.

I expected to hear from the shop about my talk, nor was I altogether disappointed, although it came in a slightly different way than I had expected. One day the foreman came to me with, "What kind of a performance did you have up at the printing office the other day?" "Why, isn't everything all right?" I asked, thinking I was in for it. "I guess they must be; the old fellow was just in and paid his bill without a kick or trying to get us to knock off anything. I had expected an awful kick, the way he was hollering the day I sent you up, Just as he was starting to leave he said, 'If I ever have to send down here for a man again, you send up the one that you sent the last time. He's so saucy he had ought to be killed, but he knows more about printing presses than your whole shop put together, and is the only man in it that I ever saw show any signs of having any brains,' and out he went. You must have been stirring things up lively in some way."

I explained what had happened as best I could, and tried to show that I generally tried to treat our customers politely, even if they did act a little rough when things went wrong, but that this time the provocation was too strong and I got going and said a good bit more than I intended to.

"It's all right," he said. "You will have to do all his work after this, and if you can hold him level without taking a club to him you are a good one." And so it proved.

W. OSBORNE.

Four "Follow" Dies.

BY JOSEPH V. WOODWORTH.

The dies in the accompanying drawings show four adaptations of the gang and follow principle for articles of sheet metal to be pierced, bent, formed or drawn, and finished complete in one operation or handling.

The punch and die, Fig. 1, produce the formed and pierced blank shown in two views at the top. This blank has two holes *B B*, the ends are trimmed and the center is drawn and formed to the shape shown at *A*. The metal came in strips or rolls of the required width, ½ inch. As first inserted in the die it fitted between the gage plates and against the stop-pin *T*. At the first down stroke of the press the forming punch *N* encounters the metal and bends and forms it in the die *R*, and, bottoming there, remains stationary while the two holes *B B* are pierced by the punches *K K* and the end of the stock is trimmed by the punch *L*. At the next stroke, the metal is held against the stop-pin *T* and the formed and finished blank is punched out. The position of the stop-pin *T* must be accurately located, as the metal is first forced against it by hand, and then drawn away some distance by the action of the forming punch *N*.

The punch and die, Fig. 3, for producing the bent flat spring shown above them are more simple than the first. They pierce the holes *C C*, make the bend at *D*, cut off the piece and trim the corners. *G G* are the piercing dies. *H* the forming or bend

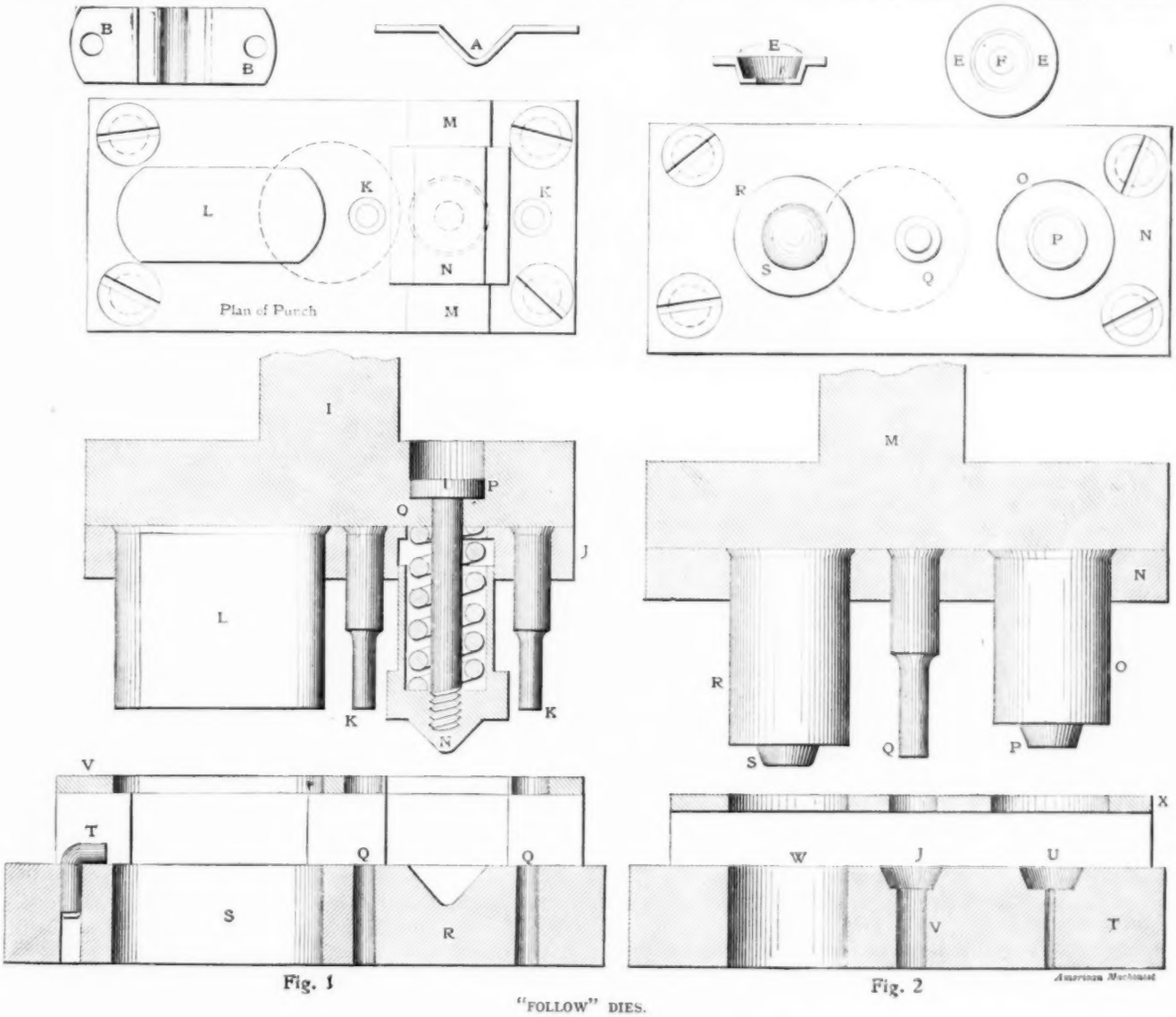


Fig. 1 Fig. 2

"FOLLOW" DIES.

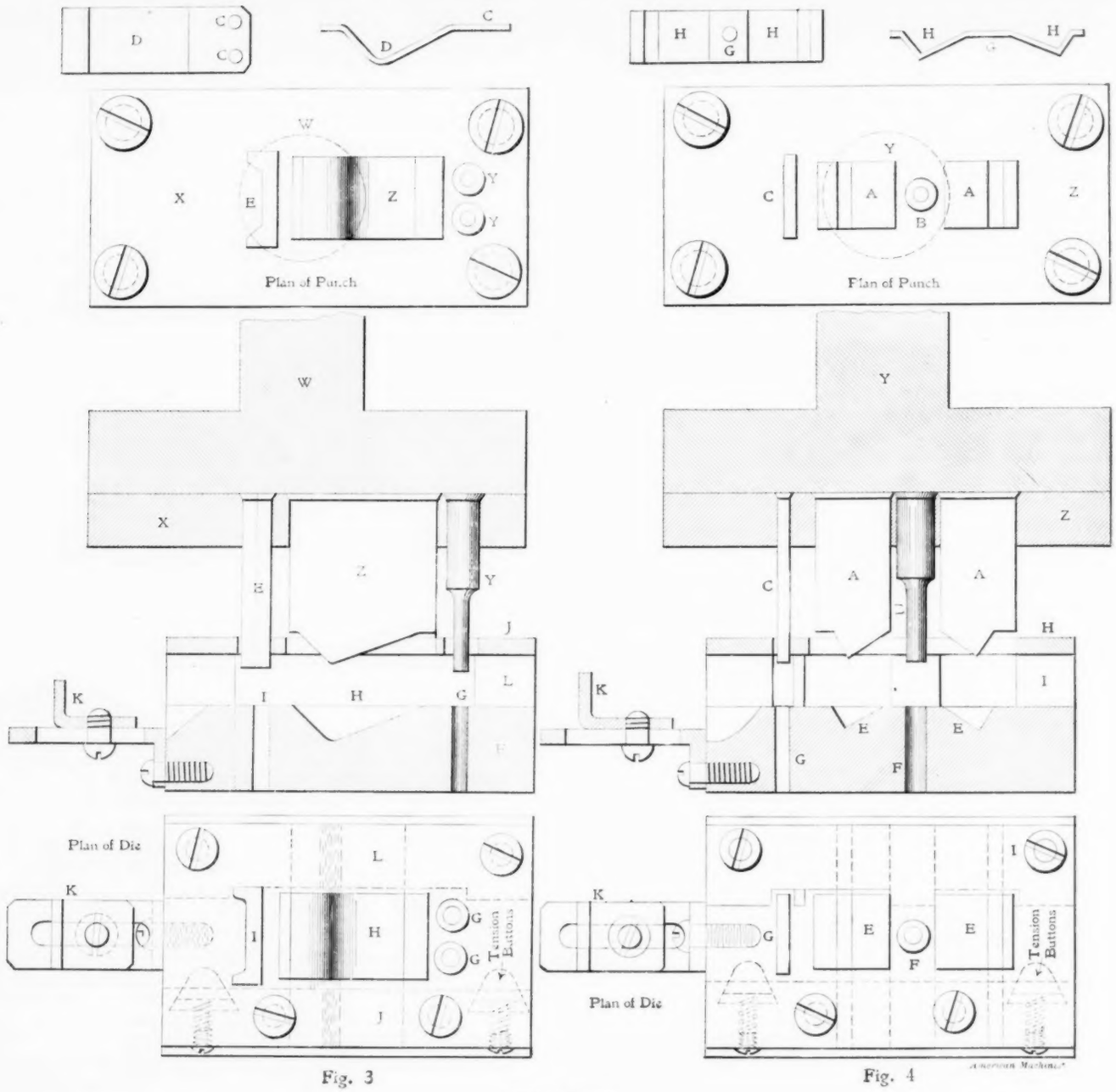


Fig. 3 Fig. 4

"FOLLOW" DIES.

ing die, and *X* and *I* the trimming and cutting-off die. For the forming die *H* the shape required is milled straight across the face of the die. The trimming die *I* also is made wider than necessary, as shown, and is made to allow the back end of the work to be cornered and the front end cut off square. The stop *K*, of flat cold-rolled sheet steel, fastened to the end of the die, is made adjustable for using the one die to produce springs of different lengths. The punch is simple, consisting of the two piercing punches *Y Y*, the bending punch *Z* and the trimming and cut-off punch *E*, all fastened in the pad *X*. The bending punch *Z* is shorter than the piercing and cut-off punches. This is so that the two holes will be pierced and the finished piece cut off before the next one is bent. When the die is in use the strip of metal, which is the exact width required, is inserted beneath the stripper and against the stop *K*. As the punch descends the two holes are pierced first, and the end of the strip is trimmed.

The only bad feature in a die of this kind is that it does not easily allow of frequent grinding. To compensate for this, it is best to leave the die as hard as possible and to exercise care when setting it up in the press. I have seen dies of this construction which have produced from seventy to eighty thousand blanks without requiring grinding.

The punch and die, Fig. 2, produce the piece shown at the top. This die, instead of bending the work, draws it to the form of a shallow shell, pierces the small hole in the center *E* and punches out the finished piece. The die comprises the drawing die *U*, the piercing die *J* and the blanking die *W*. When laying out the centers for the three dies the distances between them had to be determined according to the amount of metal required to form the shell portion of the work, as will be understood. The length of the drawing punch *P* is just sufficient to draw the shell and flatten the rim on the face of the die. The pilot pin *S* in the punch *R* is to locate the work central within the blanking die after the hole is pierced. The blanking punch is left the longest for reasons which will be understood from the description of the operation of the die.

After the punch and die are set up, the strip of metal to be worked is first entered beneath the stripper far enough to allow the first shell to be drawn at the first stroke. The metal is then moved along

one space and the shell drawn at the first stroke is centered and located within the locating portion of the piercing die. At the next stroke the hole in the center is pierced and a second shell is drawn. The stroke is then fed forward another space, and, the punch descending, the blanking punch *R* enters the die first, thereby allowing most of the metal to be drawn from the sides of the stock, and also locating true with the die. Punch *P* and the punch *O* are in separate pieces to facilitate grinding, so that when the piercing and blanking punches are ground the face of *O* also may be ground so as to keep it the proper length in relation to the other two.

The die, Fig. 4, differs from the first three, as it has to bend and form at two points *H H*, pierce a hole in the center at *F* and cut off the finished piece, thus necessitating drawing the metal for the bends in the blank from both ends. *D* is the die proper, *E E* the bending dies, *F* the piercing die and *G* the cutting-off die. *K* is the adjustable stop, *I I* the two gage plates and *H* the stripper plate. The punch consists of the stem or holder *Y*, the pad *Z*, the forming or bending punches *A A* and the cutting-off punch *C*. The forming or bending punches have the piercing punch let into the center between them. The piercing punch *B* and the cutting-off punch *C* are left 3-32 inch longer than the others, so that the forming punches *A A* will accomplish their work after the others have operated.

The stock to be worked is inserted far enough for the end to project slightly beyond the edge of the cutting die *G*. As the punch descends the piercing punch pierces the hole and the cutting-off punch trims the end. The punch continuing downward, the forming punches *A A* form the work into the dies *E E*, and the piercing punch, having passed through the stock and down into the die, holds the stock true and central while being formed. At the next stroke the stock is pushed against the stop *K* and a finished piece is cut out and dropped. The dies in Figs. 3 and 4 are used in an inclined press.

Some Things About Machine Tools.

The professional humorist may try as he may, but he can never hope to rival the man who is funny without knowing that he is funny, and we are reminded of this by looking over an article in the popular magazine known as *Success*, said article being in relation to machine tools. It is a really excellent article in many respects, and makes a good many statements that ought to be of interest to people who know very little about machine tools, as in fact most people do.

The writer gives full credit to our American tool builders for their success abroad, and in fact perhaps a little overdraws it in that line; but the funniest thing in the article is a half-tone engraving of a Brown & Sharpe milling machine which is grooving a very large hob and the inscription under this machine is "It makes four thousand hobs every minute." Any machinist will appreciate this statement, but there is no use trying to explain its absurdity to one who is not a machinist. The article is, however, well calculated to give the layman some sort of an idea of the difference between a machine tool and such common tools as are usually found about a house and that the man uses in repairing the cellar door. The writer speaks of the "whirr of the machine tool;" says that "human hands can never perform an operation twice alike;" speaks of American "planing mills" at work on armor plates in English establishments and says that some of the machine tools are used for correcting car wheels and locomotive driving wheels that after running "several thousand miles" have become "square" so that they need to be turned round again. Finally he says:

"American machine tools rank among the great achievements of the age. They are the inanimate basis of our industrial supremacy. Rapidly they are taking the places of men; and, in our great factories, where formerly stood long lines of men at the lathes, now are seen only rows of whirring automatons, with here and there a stray attendant. The day of the manless factory seems to be near. In America, we have learned that labor-saving machinery, while it may work temporary hardship for a time, in the long run helps to raise the standard of living, and makes all men richer instead of poorer."

Opportunities in India for Electrical and Textile Machinery.

A great deal of interest is now being taken by electric-plant manufacturers in the wants of the Indian market; and I believe that American exporters are anxious to secure a portion of any orders that may be given out for the supply of plants. Electric fans are very much in favor in Calcutta, one of them being driven by current from the corporation's mains. This fan makes some 200 revolutions per minute, and the result is a slow, steady breeze of great volume. Fans are generally placed 15 feet apart in cases where more than one is wanted; but this is not always the rule, because in the city cathedral they are placed 10 feet apart. It is stated that the Central Telegraph Office and the High Court prefer the 15 feet standard, while private installations vary in their number of fans according to the financial means of the householder, etc.

In Calcutta it is possible to hire fans at a cost of $1.28 per fan for one month. The Electric Supply Corporation have introduced this hiring system and the movement has become popular.

I am only aware of one city in all India where electricity is used as a power for street railroads, and that is Madras. Even Bombay—an immense city full of wealthy citizens, business, shipping and commerce—has only a limited use for electricity. The tramways are run by horse power, and gas is the illuminant in the streets. Perhaps on a fête day or someone's birthday a public park may be lighted by a portable electric plant.

It can, however, only be a matter of time—and probably only a short time—before electric power becomes largely used in Bombay and other large Indian cities. A year ago the Bombay Tramway (an American concern with head office in New York city) applied to the municipal authorities for permission to convert its power into electricity. For one or more reasons this was not immediately granted, but it has been stated that the City Commissioner intends giving the municipality electric lighting, and bids have been invited.

Rapid transit, too, must come speedily in Bombay. Rents are very high, the population is exceedingly dense, and the people are seeking homes out of the city. Undoubtedly electricity for motive power and lighting must soon be adopted in this and other leading cities.

Enormous quantities of textile machinery are annually imported into India, as the number of cotton mills increases year by year. The bulk of the trade is done by British machinists, but Germany has begun to supply some of the machines required by mills using electrical plant. There is no reason why some part of the business should not be done by American houses.

Mention may be made, in conclusion, of electric-lighting opportunities that now exist in the historic little island of St. Helena. The authorities are erecting new barracks there, and when the work is finished it will pay a small company to erect plant for lighting Ladder Hill and the town by the electric light. It has been suggested by the officials that this could be done by windmills, there being a steady wind from the South East Trades. At present the streets are lighted by kerosene oil, which is found not only expensive but faulty, the streets being in semi-darkness.

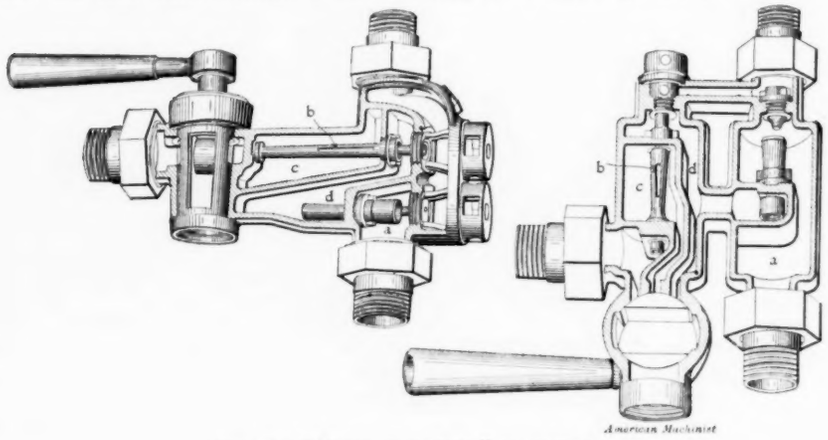
F. C. C.

A New Principle in Double Tube Injectors.

The accompanying engravings give sectional views of two new injectors, the "Easy" and the "Gem," made by Francis Sticker, 69 Beekman street, New York. These injectors are double-tube, positive working machines and show some new and original features. The machines have two sets of jets, the one called the lifter and the other the forcer. A positive working overflow cock communicates with all nozzles, and, through a simple turning with a handle, opens or closes all connections with the outside atmosphere.

The principal new element in these injectors is the direct simultaneous admission of steam from the boiler to the lifting and forcing jets. All double-tube injec-

tors heretofore constructed have steam admitted to the machines through a starting mechanism, consisting of several valves which must be worked in strict time adjustment in their relations one to the other. The reason for this is as follows: The bore of the lifting steam jet is of smaller sectional area at its smallest point than the combining tube of the lifter; therefore no back pressure is possible during the admission of steam to these nozzles. But in the forcer just the reverse is the case. Here the largest bore of the forcing steam nozzle is of greater sectional area at its smallest point than the combining and delivery tube of the forcer. Therefore the direct admission of steam to the forcer is an impossibility in such injectors, because of the pressure produced in the passage connecting the lifter and the forcer. In them steam must first be admitted to the lifter, and after water is lifted to the injector the lifting side overflow is closed, and the mixture of steam and water has been forced into the forcing combining tube and out through same; steam is then slowly admitted through forcing steam nozzles, and when a perfect current is established and every valve works in perfect unison, the injector is ready for work.



THE "EASY" AND THE "GEM" INJECTORS.

With the machines under description steam is admitted simultaneously to the lifting and forcing steam jets, direct from the boiler. The velocity of the steam passing through the tubes of the lifter and out to the atmosphere, creates a partial vacuum in the water chamber *a* of the lifter, in consequence of which the pressure of the outside atmosphere will force the water into this chamber.

The steam entering through the steam jet to the forcer is also unhindered on account of the longitudinal lateral escape passages *b* in the forcing combining tube, through which any excess of steam which cannot find an outlet through the small sectional area of the delivery tube, finds a direct outlet to the atmosphere through chamber *c* and the overflow cock. The formation of pressure in the passage *d* connecting the lifter and forcer is thus impossible. On the contrary, the velocity of the steam entering the forcing steam jet results in the formation of a partial vacuum in this chamber, and the forcer thus serves also as an additional lifter during the starting operation and gives so much additional lifting power.

On account of this lifting power of the forcer, the water discharged by the lifter is instantaneously and automatically taken up by the forcer, even with an open overflow, no special construction being needed to secure the entrance of the water into the forcer.

The whole operation of starting the injector consists in opening the steam valve and turning the handle of the overflow cock in line with the boiler outlet. The moment steam enters the injector, water appears at the overflow, and all that remains for the operator to do is to close the overflow cock.

The machines are made of capacities from 10 to 20,000 gallons per hour, the former size being the smallest injector ever made and being intended especially for automobile use.

Mineral Output of the United States in 1900.

The Department of the Interior at Washington has published a 927-page volume on "Mineral Resources of the United States, Calendar Year 1900." It is compiled by David T. Day, Chief of Division of Mining and Mineral Resources.

A comparison of some of our mineral industries as set forth by the United States Geological Survey in the "Mineral Resources of the United States, 1900," shows how small a part, relatively, the two precious metals play in adding to our national wealth.

Round numbers alone being used for convenience sake, it is found that the gold product was worth $79,000,000, and that the commercial value of the silver product was about $36,000,000, though the coining value was $74,000,000. As metals, then, the gold and silver were worth $115,000,000; as money they were worth $153,000,000. Now, the copper produced in 1900 was valued at $98,000,000, though the price decreased a cent and a half a pound, as compared with 1899; the lead was valued at over $23,000,000, though the condition of the industry was not good; zinc was produced to the value of over $10,000,000, though it declined 28 per cent. in value, as compared with 1899. The copper, lead, and zinc products were worth more as metals by $16,000,000 than our gold and silver as metals in 1900. Again, the combined values of the production of abrasive materials, such as grindstones, garnets, and so on; of chemical materials, such as gypsum, phosphate rock, and others; of pigments, such as metallic paint, white lead, and so on; and of the miscellaneous metallic products, the whole aggregate being about $52,000,000, show that they were worth less as metals or metallic products than the gold by about $27,000,000, and more than the silver as a metal by $16,000,000.

Further, the comparison of gold and silver with the structural materials produced —that is, with $48,000,000 of building stone, $96,000,000 worth of clay products, and $13,000,000 of cements, $157,000,000 in all—shows that the structural materials exceeded the gold and silver in value by $42,000,000, if the commercial value of silver is taken, and by $4,000,000, even if silver is taken at its coining value of $74,000,000.

Applied to iron and its products, the comparison becomes still more striking. Iron ore was produced to within less than $9,000,000 of the value of the gold; and pig iron was produced to a value of nearly $107,000,000 in excess of the coining value of both gold and silver combined. But the comparison of the gold and silver output with the output of the mineral fuels, coal, petroleum and natural gas is the most striking of all, for the combined gold and silver value is exceeded by the sum of $253,000,000, or $406,000,000, as against $153,000,000.

These comparisons are the more interesting in view of the statements of the Director of the Mint that "two-thirds of the output of silver in the United States is obtained as a by-product from mines which would be operated no matter what the price of silver might be," and that in the Cripple Creek district the "reserves (of gold) in sight are enormous."

We made tin plates and terne plates to the amount of 302,665 long tons, notwithstanding the fact that no block tin was produced, the metal being imported from abroad.

An Incident.

In *Social Service* for January is a quotation from a letter from Col. James Kilbourne, president of The Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, as follows:

"We have always endeavored to treat our employees as men, with the same feelings, hopes and rights as ourselves, and to consider that we are all of us one great family with mutual interests. I have not begun to do as much for our employees as they have done for me, but have endeavored to treat always as I should like

to be treated if our positions were reversed. Our relations for nearly thirty years have been always friendly and satisfactory; we have never had any strikes or troubles of any kind, but this is owing as much, if not more, to the character of our employees. As illustrative of this I will tell you of an incident which occurred during the panic of '93:

"A month or so after the panic began, and when large concerns were failing in every direction, there filed into my office one morning some fifteen or twenty men, representing the several shops in our plant. Their manner and looks were serious, and while I had no more earnest wish than that I should never have any trouble with our employees, I feared that it had come at last. Finally one of them, as spokesman, said that they had thought very long over the matter that had brought them there before they had decided to come, and that they had hoped they would find me

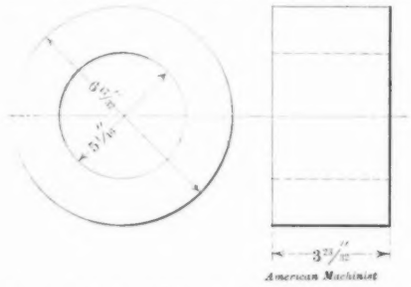


FIG. 1. BRASS BUSHING FOR A LOCOMOTIVE ROD.

prepared to accede to their request; that they had noticed that large concerns who had stood the stress of many panics were failing every day; that our warehouses were filling with goods which we couldn't sell, and that they presumed we, like others, were unable to obtain payment for goods already sold and that they feared that we might be in danger as well as other concerns; that some of them had been with us for a few years, some for many years, and some the length of a generation; that they had always received fair wages and had been able to save some money, and while the individual savings were not large, the aggregate was a considerable sum, and that they had come to tell me the whole of it was at my disposal for the use of the company if it were needed.

"I will leave you to imagine what my feelings were, for I have never, from that date to this, been able to find words in which to suitably express them.

"This is one of the many instances of their consideration, and, therefore, if you are seeking to say anything about us in *Social Service,* confine what you have to say to the loyalty and good character of our employees rather than anything about ourselves."

Five Important Markings for a Draftsman's Slide-Rule.

BY GEO. F. SUMMERS.

The accompanying diagram illustrates the value of special markings on a slide-rule. In this case the marks are put as follows:

1128 for volumes of cylinders,
2023 for weights in pounds of brass cylinders measured in inches,
2120 for weights in pounds of steel cylinders measured in inches,
2141 for weights in pounds of wrought-iron cylinders measured in inches,
2213 for weights in pounds of cast-iron cylinders measured in inches.

By scratching these lines on scale *B* of the rule and coloring with different inks, given the diameter and length, a draftsman is able to obtain the result at one reading.

Fig. 1 is a drawing of an Ajax metal bushing, picked at random from a pile in the shop, waiting to go into locomotive connecting rods.

Setting the slide-rule as at Fig. 2, we read instantly that the hole weighs 23.3 pounds—that is, the mark *b* for brass on line *B* is put opposite the diameter 5 1-16 inches (= 5.06) on line *A*. Opposite the length, 3 23-32 inches (= 3.72), on line *C* is read the weight in pounds, 23.3, on line *D*.

With another setting in the same manner we read: A brass cylinder 6 17-32 inches diameter and 3 23-32 inches long weighs 38.8 pounds. The difference, 38.8 — 23.3 = 15.5 pounds = the weight of the bushing.

To prove my illustration I had the bushing put on the scales. It weighed 15 pounds 4½ ounces.

In a similar manner the cubic inches may be found as in Fig. 3.

[It frequently happens in problems involving the use of the lower scales, that the answer cannot be read, because it is "in the air." Thus in Fig. 3 if the length of the cylinder is 6 inches the answer cannot be found with the setting shown. In such a case it is necessary only to mark the position of 1 on the *B* scale with the runner and then push the slide to the left until the right-hand 1 comes to this point, when the problems whose answers are now in the air will fall on the scales, and *vice versa.*—Ed.]

The Secret of Success.

The secret of the success of the great business enterprises of the world lies in the talent of some man at the head to get folks who can do things and then let them alone to do them. It requires much less talent and genius to find the man to "deliver the message" than to keep your hands off and let him do it. One business that the writer knows of has practically reached the limit of its expansion because the man at the head of it isn't big enough to let folks do things; he is always interfering with his method; his employees have no individuality in their work; they try to do it "to please the old man" rather than to promote the business, but he doesn't encourage the expression of them; he overrides new suggestions because they "cost too much" or because he doesn't "consider them practical," or because the man who

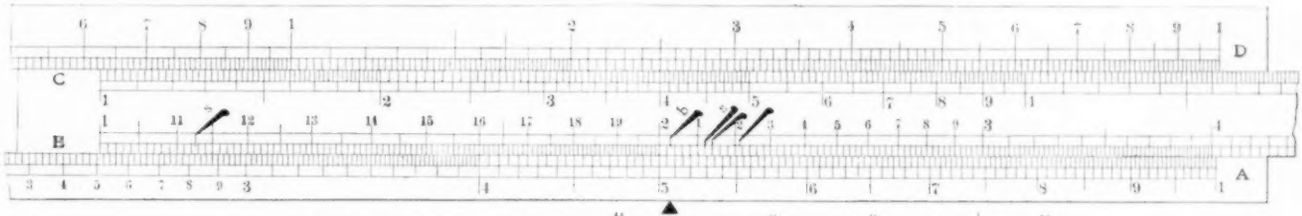


Fig. 2: Showing a slide-rule set to read "A brass cylinder 5 1/16" diam. x 3 23/32" long weighs 23.3 lbs."

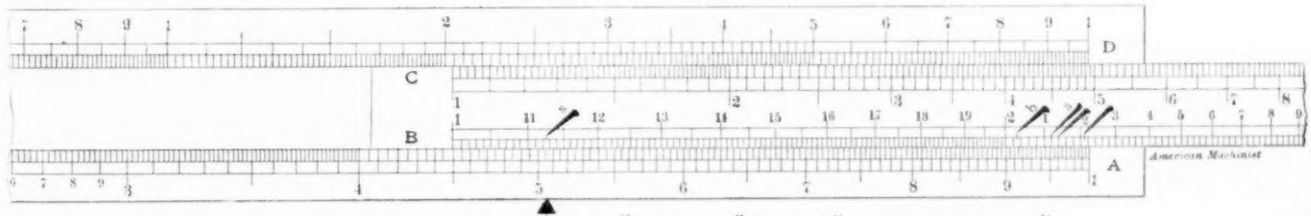


Fig. 3: Showing a slide-rule set to read "A cylinder 5 1/16" diam. x 3 23/32" long contains 74.9 cu. in."

makes the suggestions "doesn't know anything about it." A discouraging case for an employee who really wants to improve his own condition by improving the business he is in.—*Ad. Sense.*

Some Points About Babbitting.

BY F. WERTHEIM.

The space recently allotted to this subject by the AMERICAN MACHINIST has led me to present these notes, which are the result of observation during my life as a traveling "jour.," and of the perusal of mechanical periodicals.

Mr. Bollinckx's method of securing babbitt to bearings, shown at page 483, Vol. 24, has the prestige of long and general use, and will very likely continue to be used, but I ask your readers whether Figs. 1 and 2 do not show a better way. Mr. Bollinckx's way consumes too much time in the foundry. Again, few, or comparatively few, American shops have adequate facilities for cleaning castings, so that here it takes too long for the machinist to get the core sand from all the conical holes. The best bearings are secured only when the babbitt is poured into clean boxes. It is no uncommon job to rebabbitt a bearing, and often conditions compel the machinist to remove the old babbitt with hammer and cold chisel. I have repeatedly been injured, and seen others injured, in chipping the babbitt from those cored holes.

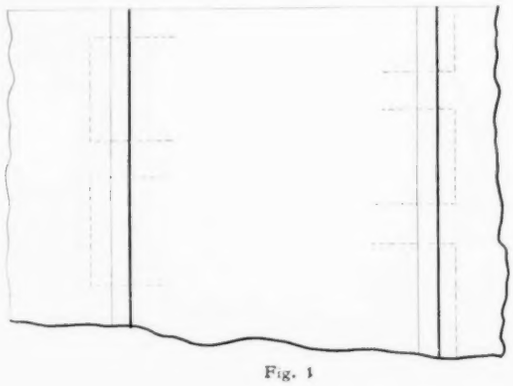


Fig. 1

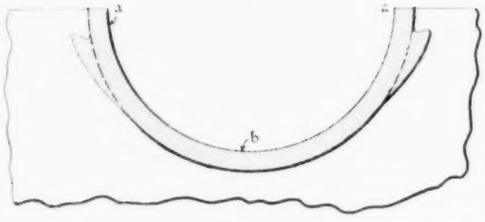


Fig. 2

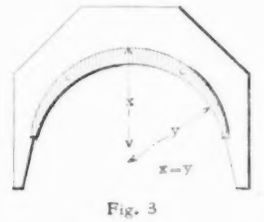


Fig. 3

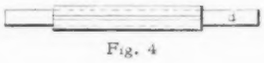


Fig. 4

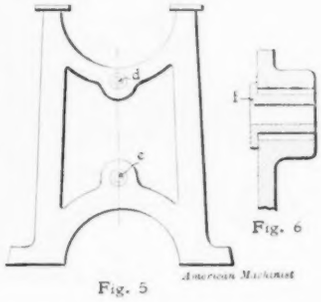


Fig. 5

Fig. 6

BABBITTING JOURNALS.

Figs. 1 and 2 were shown in these columns years and years ago by one of your correspondents, named Porter. This method will please the foundry foreman; the castings will be easy to clean, and if the bearing is to be pened and bored, the pening will cause the babbitt to hold still tighter. Should this bearing run hot, the metal will be drawn to its seat, the corners *a a* being drawn away from the shaft, instead of pinching it. When repairing, the babbitt can be removed before the ladle is hot, by chipping a groove through the center of bearing at *b*.

Fig. 3 shows a form of journal used by the Chicago, Rock Island & Pacific Railway for locomotive and, I think, for other bearings. The brasses are bored a running fit on the axle, the bored surface is tinned, and then, using an arbor the same size as the axle, the babbitt *c c* is poured. Should the journal become so hot as to melt out the babbitt, the brass will of course come to a good bearing.

The National Elevator & Machine Company, of Honesdale, Pa., had certain bearings to babbitt which were solid—that is, they had no cap—and they used the mandrel shown in Fig. 4 to avoid the difficulty of removing the mandrel due to the gripping of it by the babbitt. The mandrel consists of a central plug *d* and a split bushing. In use the split in the bushing was filled with putty. After pouring, the central plug was removed and it was then easy to remove the split bushing.

One of the neatest bits of designing I have seen was on one of the shirt ironers built by the Troy Laundry Machinery Company. I think it was originated by Mr. Geo. Roberts, who was superintendent while I worked there. The ironer had a light frame, something like Fig. 5, with shaft bearings at *d* and *e*. The shafts were slipped through the cored holes at *d* and *e*, when brass bushings *f*, Fig. 6, were slipped into the cored holes, the gears were put on the shafts, the shafts leveled and located, and then babbitt was poured between the brass bushings and the cored holes in the frame. Except for an oil hole and groove, those bearings were then complete. There was none of the filing, fussing, scraping and swearing, the usual factors in assembling machines of this type, viz.: two frames bolted together, and sometimes bolted to a bed plate as well, and having bearings and studs for numerous shafts, gears or cams. Mr. Roberts applied the idea to a simple ironer. I believe it would be very valuable in constructing machinery of the type I have mentioned—that is, where these machines are not made in sufficient quantity to be jigged. The usual practice is to machine, bore and babbitt the frames singly, and then, when assembling, endless fitting is required to bring the bearings into line and the parts into correct position.

The brass bushings, Fig. 6, were bored, reamed and faced, but were left rough on the outside.

The large granite lathe built for turning the columns of the new cathedral in New York has babbitt bearings for the spindles. These are large bearings, and have to withstand enormous pressure, so the babbitt receptacles have ribs cast in them, forming pockets to keep the babbitt from being squeezed out. In the very large Westinghouse bearing recently shown in the AMERICAN MACHINIST, this construction is not used, though these bearings are meant for heavy loads.

Two things are still the cause of the detestation most machinists have for a job of babbitting. The first, sore eyes; the second, that old eye-sore—the coal forge. The mica goggles used by wood butchers to protect the eyes from flying splinters should be used by machinists to prevent flying bits of tool steel or babbitt from entering the eye. The purchase of this trifle need not be left to the purchasing agent, because there are cheaper celluloid goggles on the market.

A Patent Guarantee Company.

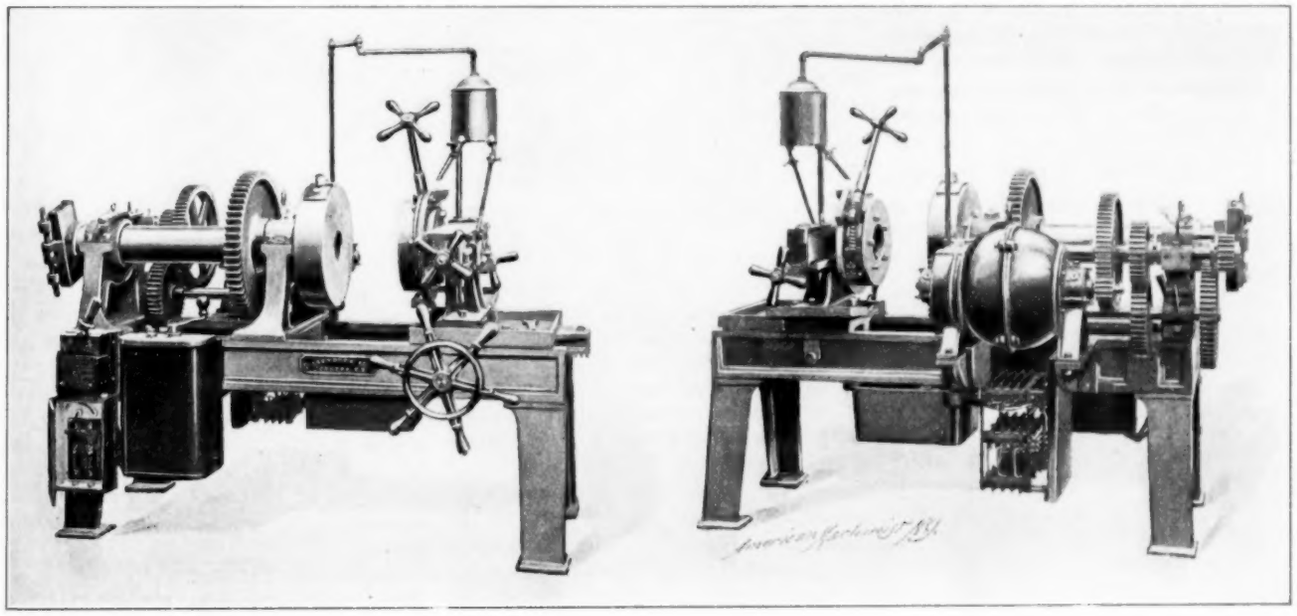
The Patent Title and Guarantee Company, Inc., of 150 Broadway, New York, is the name of a concern which is carrying on a business that will probably be new to most of our readers as it is to us, though we learn it has been going on for some time. The object of this company is to guarantee titles in patent rights. In other words, it undertakes to examine the validity of a patent claim and to guarantee it; that is, to defend the patent from all infringements and to pay the holder any damages which he may sustain from infringements. Its business is of much the same nature as that of companies which guarantee real-estate titles. In addition to this the company named gives its policy holders the right to use its seal on patents, trade marks or copyrights, saying that it is protected by the Patent Title and Guarantee Company, which, as may be readily seen, carries with it considerable moral effect.

Electrically-Driven Pipe Threading Machine.

The accompanying illustrations show a pipe threading machine equipped for electric driving, as arranged by D. Saunders' Sons, Yonkers, N. Y. The requirements in such machines are somewhat different from those in other lines of machine tools. In addition to the usual range in the speeds is the necessity of providing for motion in both directions and for extra effort when putting on or taking off couplings as well as in cutting the threads when the dies are dull. In putting on couplings, for instance, they must be screwed home, and in removing them, especially if they have been long in place, about as much force must be exerted. To provide for these conditions the motor must be protected from the tremendous rush of current through it as the resistance increases, and this is provided by a circuit breaker, seen at the left of the controller in Fig. 1. As an additional precaution fuses are provided in connection with a main line knife-edge switch. These are enclosed in an asbestos-lined box located below the circuit breaker in Fig. 1.

The motor is fitted with both armature and field resistance and has eight rates of speed, which are obtained through a controller of the street-car type. This number of speeds is doubled by the provision of two sets of back gears. To operate the machine in both directions an extra reversing cylinder is provided, which is mounted alongside the main cyinder in the controller.

The resistance coils are mounted in cast-iron boxes which are oil and fire proof. A Lundell motor is used, which is entirely enclosed, with suitable trap doors at the commutator end to give access to the interior.



SAUNDERS' ELECTRICALLY DRIVEN PIPE THREADING MACHINE.

American Methods Through English Eyes.

At a meeting of the British Institution of Civil Engineers on Tuesday, January 14, a paper on "American Workshop Methods in Steel Construction" was read by H. B. Molesworth.

The author, in noticing the fact that many recent contracts for steelwork had been secured by American manufacturers in competition with English firms, suggested that a description of American methods would be advantageous. The quality of American first-class work was excellent, in design, material, workmanship and finish, and was fully equal to English work. The cost of labor, though higher as regarded the amount earned by individual workmen, was lower than in England when the quantity of work turned out was taken into account. English bridge-works were frequently cramped for room and hampered with old-fashioned and obsolete machinery, while American works were kept up to modern requirements and obsolete machinery was turned out as soon as it was superseded by anything more efficient. Works in America usually ran night and day, and American workmen took fewer holidays than English workmen.

The author confined his description to the bridge department of the Pencoyd Works of the American Bridge Company, near Philadelphia, and after giving a general description of the works, traced the material from the bridge-shop yard through the various processes into the loading-up yard, whence it was shipped. The bridge shop was electrically driven, the cranes and larger machines having each its independent motor. The material was moved longitudinally through the shop on trollies and transversely by electric cranes, the shop was roofed in, and the floor was boarded; the material rested almost entirely on skids, and every process moved it farther along the shop till the finished work emerged at the opposite end to that at which the steel entered. The output in gross tons per man, per annum, averaged: Draftsmen, 771; bridge shop, 115; forge, 45; eyebars, 185; templeters, 2,366.

The steel was open-hearth steel, rather softer than was generally used in England, of excellent quality, and giving very uniform tests. The greatest care was taken to deliver all material into the bridge-shop yard perfectly straightened. The drawings were prepared in a very complete manner and gave much more information than was usually furnished on drawings in England. Great care was taken to minimize smith's work, and to duplicate as many parts as possible. Stops, guides, automatic spacing punches and multiple punches were largely used. The angle-shear was used much more than in England, and joists of the largest size were sheared at one cut without any distortion; punches and dies were all made on automatic lathes and were interchangeable. All the larger shearing machines were mounted on turntables. Plates were handled under punches by roller frames or goose-necks and moved by a chisel bar working on a fulcrum. Reaming was done by gantry drills, which resembled a Wellington crane with eight radial drills on it. Pneumatic drills and riveters and chipping machines of the Boer type were much used, and bad holes, which were very uncommon, were reamed and not drifted. Ends of long pieces were reamed or drilled by compressed-air drills fed up to the work by a compressed-air cylinder behind them

Large plate girders were riveted by hydraulic gap riveters mounted on a ram to raise or lower them, the work being suspended from an electric Wellington crane traversed by a switch on the riveter platform. Ends of members were milled by rotary planers which had heads 4 feet 6 inches to 6 feet in diameter, with cutters fixed near the periphery. Angle stiffeners were bevelled in pairs in a milling machine with fast vertical feed, and fitted perfectly. Large joists or channels were handled with clip hooks furnished with chisel points.

Very little planing was done in the works; "Universal" plates were used, and were rolled by nearly all American plate mills without extra charge.

The causes of cheap working in America might be summed up as follows:

1. The workmen, though more highly paid than in England, turned out a much larger quantity of work.

2. The arrangement of the works was more carefully thought out, and the labor-saving appliances were more used.

3. There was more method, and probably more scientific knowledge, in the drawing office.

4. The works were run night and day.

5. The templeting was reduced to a minimum by care in the drawing office and by the use of automatic machinery and stops and guides.

6. Obsolete machinery was turned out of the works as soon as it was superseded by anything better.

7. All tools were kept in a state of perfect efficiency.

8. Railway freights were lower than in England.

The responsibility for the small output per man in England rested only partially with the manufacturer, who was hampered in every effort to introduce improvements by the action of the workmen. The author suggested improvement on the following lines:

(a) A careful arrangement of works to avoid unnecessary handling and give ample facilities for such as was necessary.

(b) More complete drawings.

(c) The condemnation and removal of obsolete machinery and the proper maintenance of what was in use.

(d) Ample motive power.

(e) The more extended use of stops, guides and multiple and spacing punches.

The saving which was possible by systematic methods in the drawing office, and the use of stops and guides and multiple punches, so as to reduce the templeting, was very great. Small portions of the work should be made interchangeable and turned out without having to mark each piece. The use of the spacing punch obviated the necessity for wooden templets and for marking.

The Franklin Institute and the Metric System.

February 19 at a meeting of the Franklin Institute in Philadelphia the report of a special committee appointed to consider and report as to the feasibility and advisability of the adoption of the metric system of weights and measures will be discussed and acted upon. The committee is composed of the following members:

James Christie, American Bridge Company, Pencoyd, Pa.

A. E. Kennelly, Houston & Kennelly, electrical engineers.

P. E. Ives, photographer and engraver.

Wilfred Lewis, president Tabor Machine Company.

S. M. Vauclain, superintendent Baldwin Locomotive Works.

Jesse Pawling, Jr., instructor in physics, Central High School.

George F. Stradling, instructor in physics, N. E. Manual Training School.

Harry F. Keller, professor of chemistry, Central High School.

A. Falkenau, machinist.

L. F. Rondinella, instructor in engineering, Central Manual Training School.

And its report is as follows:

Whereas, It is desirable to obtain an international standard of weights and measures, also to simplify and regulate some of our existing standards, and

Whereas, The metric system is commendable not only as a suitable international standard, but also for facility of computation, convenience in memorizing and simplicity of enumeration;

Resolved, That the Franklin Institute approves of any movement which will promote the universal introduction of the metric system with the least confusion and expense.

Resolved, That the national government should enact such laws as will ensure the adoption of the metric system of weights and measures as the sole standard in its various departments as rapidly as may be consistent with the public service.

The following questions were discussed at a meeting of a sub-committee, January 17, and the answers as given were agreed to:

1. Assuming the desirability of an international standard, could we expect nations using the metric system to abandon that and adopt our system? No.

2. Can we not concede the advantages of the metric system for purposes of computation, and also as being readily memorized and the relations between weights and measures borne in mind without much effort? Yes.

3. Have any valid objections against the metric system been effectively urged, excepting that the numeration cannot be continuously subdivided by two? No.

4. Is not this similar objection to our decimal currency overcome by the advantages of the system? Yes.

5. For convenient minimum units of hand rules, is not the m/m better than either 1-16 or 1-32 inch, the latter being rather a fine subdivision for ordinary rough measurements? The m/m is equally as convenient.

6. Assuming that the change in our system could be effected without serious expense or confusion, could we recommend this change as desirable? Yes.

7. Could not such a change be fairly initiated if the national government would adopt the system in all its departments, where no serious confusion would occur from an early change, gradually extending the system to other departments, when people became accustomed to its use, and tools were accumulated which conformed to the new standard? Yes.

8. In the workshops could not a large proportion of existing tools and gages be retained until they were gradually superseded, merely designating their nominal dimensions in the nearest convenient metric units? We anticipate no prolonged serious confusion.

9. If in the course of a term of years the system came into universal use in the service of the government, is it probable that its adoption would follow elsewhere within a reasonable time? Yes.

10. Would it appear to be practicable to inaugurate the adoption of the metric standards for weights or for liquid measures in advance of linear measures, as the former would not involve the abandonment of such numerous and costly tools as would the latter? No.

The names of most of the members of this committee are very well known in engineering and machinery circles and their report is bound to carry a great deal of weight. The discussion at the meeting of the Institute and the action that may be taken by this most conservative and careful of all American scientific or technical association will be awaited with much interest.

Some Comparisons of Wages and Cost of Living.

We have referred to some remarks of Mr. Carnegie's about the cost of living and the tendency of wages to rise, and bearing on the subject we find a letter in the "New York Times" which will be read with interest as the experience of a machinist evidently intelligent and with a memory. His letter is dated Jersey City and his experience has evidently been in the vicinity of New York, where we think conditions for workmen are far inferior to those that obtain in most other parts of the country. The letter is as follows

"Mr. Andrew Carnegie contends that the condition of the workingman is better now than in former times, if the cost of living is taken into consideration. This, I think, needs an answer from someone more intimately familiar with the everyday life of the wage earner as it was a half century ago and as it now is. Mr. Carnegie prefers to run his comparisons back for a generation, which, I suppose, means to him about thirty-five to forty years. This, I think, is unfair, as it stops right in the

period of the greatest war in our history, and the greatest disturbance of values and financial standards the world has ever known.

"During that period of financial chaos the price of labor went up with everything else. Then I could earn at my trade as a machinist $25 or $30 per week, and as high as 50 cents an hour was paid laborers as helpers. Not much more than half as much is now paid in the same line.

"Any just and fair comparison of this kind must run back to the decade before the civil war, and I propose with the kindness of "The Times" to make a few comparisons between the two periods, similar in many respects, while those of Mr. Carnegie are as unlike as any two that could be named in our history as a nation.

"In 1852 I had finished my apprenticeship and commenced work as a machinist near the city of Waterbury, Conn., in the employ of a concern that afterward became one of the largest corporations of the country. I earned $2.50 a day. My board cost $3 per week, which included washing, ironing and mending, and I was within five minutes' walk of where I worked. In 1854 I came to New York and worked at my trade for $20 per week. Board on St. John's Park, within five blocks of my work, $4.50 per week. This was not a mechanics' boarding house, but quite tony in those days. In 1857 I married and commenced housekeeping on Bergen Heights. We had four rooms on the second floor, for which we paid $6 per month, the family who owned the house and ourselves, six persons, being the sole occupants. It would be hard to find now as good accommodations at double the rent. The cost of living was not higher than now, fuel about the same, flour a little higher, butter, eggs, and milk much cheaper, meat at least 25 per cent. cheaper, church rates and doctor's charges hardly more than half what they now are.

"As regards clothing and other expenses. In 1852 I could buy an all-wool, custom-made suit of clothes for $25 to $30, which were better made and which would last twice as long as one you would pay about as much for now. You could then buy a broadcloth circular cloak for $15, or a shawl, which was in fashion then, for $9 or $10. These were as dressy and as serviceable as any $25 overcoat of to-day. Let me remind Mr. Carnegie that we had penny daily newspapers then as now, some of the stage lines carried their passengers for 3 cents, and the Brooklyn cars theirs for 4 cents. It might interest others to know that a ticket to the theatre or circus cost a quarter, and a good cigar or a glass of ale 3 cents. There were plenty of good bakeries run by clean, respectable American families where pure food could be got at prices below what is now charged for worthless trash.

"In the particular line of work in which I have been employed the number of workmen has never been equal to the demand, and still the wages are constantly being lowered and are now about two-thirds what they were in 1855 to 1860.

"I would like to ask Mr. Carnegie if he considers the prevailing rate of wages—about 25 cents an hour—a just and equitable compensation for the skill, judgment and hard mental and muscular labor required for the duties of the up-to-date machinist or general mechanic. And yet some of the largest corporations are advertising for men at this rate, and for ten hours each day for day or night work.

"If Mr. Carnegie, whom I greatly respect, will use his splendid abilities to educate the wage earner so that he can live honestly and respectably on the prevailing rate of wages, or show how he can obtain better pay, he will earn the gratitude of the most important portion of our people, the hard workers, whom he himself characterizes as the most self-respecting body of men he has ever known. Should he do this there is no danger of his dying disgraced, even if he should die rich.

"A Veteran Observer.

"Jersey City, N. J., Jan. 30, 1902."

A New Measuring Machine.

We illustrate herewith a standard measuring machine which has been developed recently by the John M. Rogers, Boat, Gauge & Drill Works, of Gloucester City, N. J., on which machine a system of multiplying levers is used for gaging the pressure on the piece being measured so as to eliminate the personal factor.

The machine will be seen to be similar in general appearance to others in general use. It, however, stands on three feet of small area and is thus not affected by the unevenness of the surface on which it is placed. The chief new feature, however, lies in the tension gage and indicator by which uniform pressure between the contact points and the piece being measured is insured.

The front, rear and top views, Figs. 1, 2 and 3, show the general form of the machine clearly and the sectional view of the indicating head, Fig. 4, shows the tension gage and indicator which is composed of levers *B* and *C*, the former having on the upper end a yoke spanning the spindle and connected to it on each side by links *A* and turning on the trunnion just below the spindle. Levers *B* and *C* are connected at the lower ends with a link, and lever *C* turns on a trunnion just above this link, the trunnion being placed above instead of below the link so as to avoid any false movement which might be caused by flexure

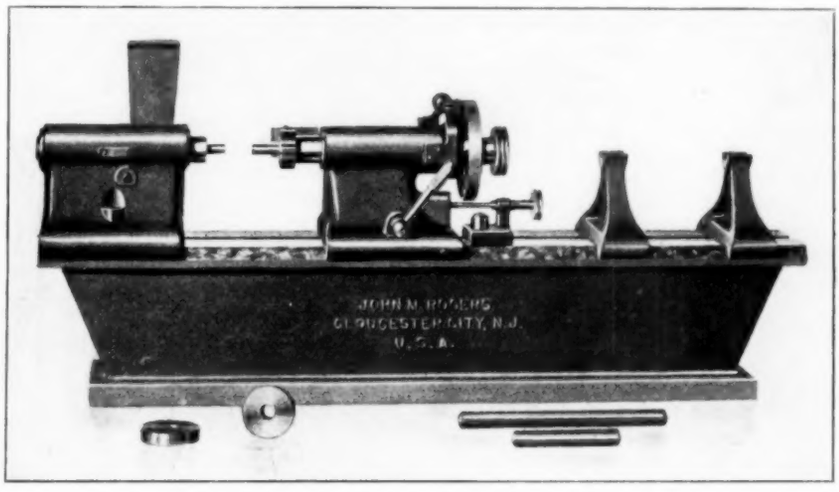


FIG. 1. FRONT VIEW OF MEASURING MACHINE.

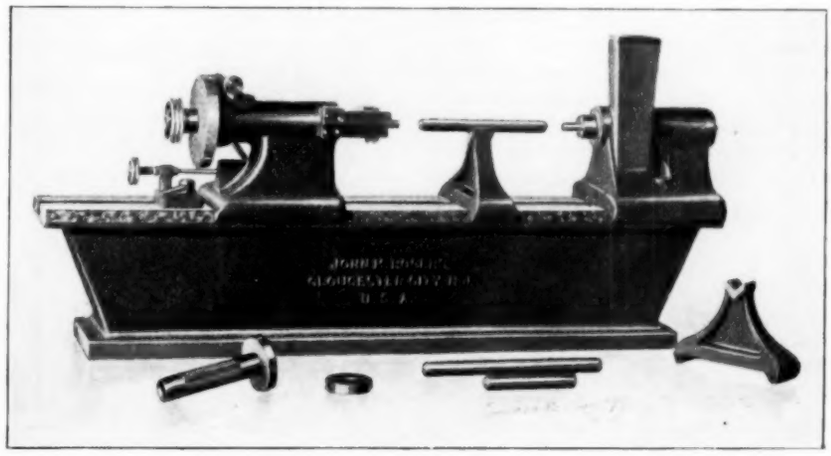


FIG. 2. REAR VIEW OF MEASURING MACHINE.

should the lever *C* swivel on a trunnion pin placed below the connecting link.

In order to set the dial of the machine at zero, which operation must be carried out before any work is measured, the measuring points are brought in contact, the movable head is clamped in position and the measuring screw is turned, thus giving movement to the system of levers. This

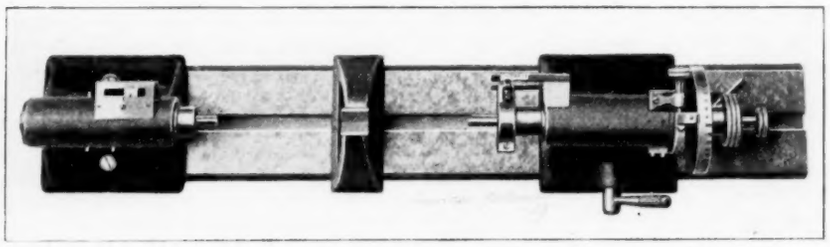


FIG. 3. TOP VIEW OF MEASURING MACHINE.

is continued until the graduation mark on the end of lever *C* coincides with a mark on the index plate *E*. Both these marks are to be seen in Fig. 3. The index pointer of the graduated dial on the movable head, seen at the right in Fig. 3, is then set to zero. The spindle on the index head can then be run back and the operation be repeated an indefinite number of times and by different operators and the two indexes will come to zero simultaneously, as the helical spring *F* and weight *D* insure positively uniform pressure between the contact points at all times. For measuring long pieces, standard distance pieces or end measure, rods are inserted between the contact points, as shown in one of the illustrations, the fractional parts of an inch being determined by the screw and graduated dial in the usual way. The movement of the upper end of lever *C* is so great in proportion to the movement of the spindle that the machine is extremely easy to operate and at the same time very sensitive. After the pressure is relieved from the measuring points the levers are carried back to their original position by the helical spring operating against the back end of the spindle and the weight *D* operating on lever *C*.

This device, aside from its simplicity in design and accuracy in operation, exerts sufficient pressure to keep the work square with the measuring points, which is particularly convenient when long and heavy gages are being handled. The approach of the graduation mark on the lever to its mate can be watched, the operator coming up boldly at first and using care only at the last. Should the movement be carried too far, it is shown at once by the passing of the marks, when the pressure can be slightly relieved and the operation be repeated instead of starting in anew.

The screw in the movable head has a 50-pitch thread, and the dial is graduated to 400 divisions, giving direct readings to 1-20,000 (.00005) part of an inch.

The machines are built in two sizes, viz.: 0 to 12 inches and 0 to 24 inches, and they are also furnished to measure in the metric system.

New French Patent Regulations.

United States Consul Hilary S. Brunot sends from St. Etienne the following information concerning the present patent regulations of France:

In order that a patent may be obtained in France, the three following conditions are necessary: That the invention be absolutely new; that it possess an industrial character; that it be not contrary to public order or security, good morals, or the laws of the country. An invention is not considered new when, previous to the date of filing of the application, it has received sufficient publicity in France or abroad to render it easy of imitation.

The patents are not guaranteed by the government, which delivers them at the risk and peril of the applicant; there may be noticed on thousands of patented inventions the letters "S. G. D. G.," meaning "without the guaranty of the government."

The cost of a French patent is 500 francs ($96.50) for five years, 1,000 francs ($193)

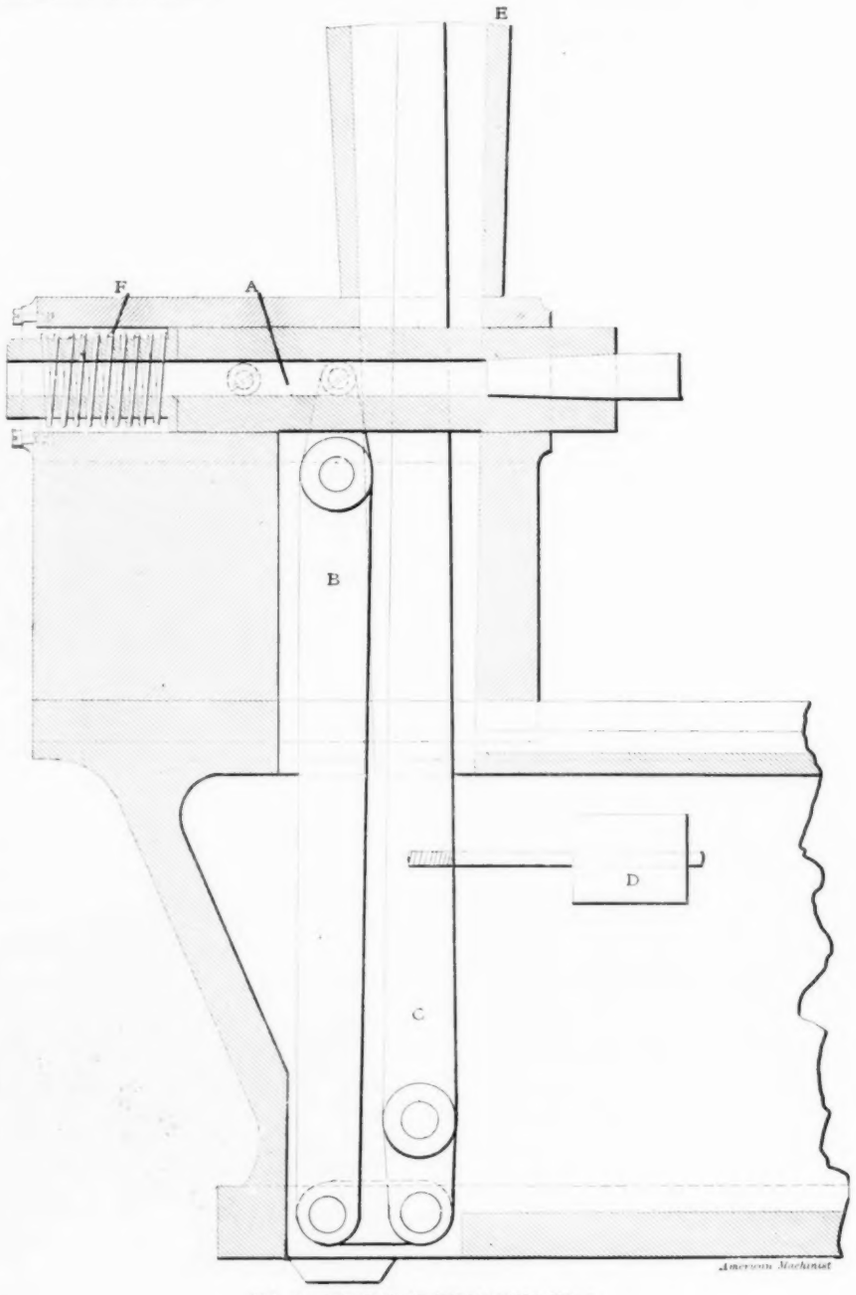


FIG. 4. SECTION OF INDICATING HEAD.

for ten years, and 1,500 francs ($289.50) for fifteen years. This tax is paid in annuities of 100 francs ($19.30) in advance.

To obtain a patent every inventor must file at the prefecture of his department:

(*a*) An application to the Minister of Commerce and Industry in which is mentioned the subject of his invention as well as the desired duration of the patent.

(*b*) A complete description of the invention, in duplicate.

(*c*) Drawings or specimens necessary to the understanding of the description, also in duplicate.

(*d*) A list of the papers thus filed.

The decree above alluded to concerns exclusively the drawings and descriptions of the inventions. The first article prescribes that the descriptions must be written with the pen in a clear hand or printed on paper 33 centimeters long by 21 broad (12¾x8 inches), leaving a margin of 4 centimeters (1½ inches). One side of the paper only must be used, and no design is allowed in the text. The second article refers to the drawings.

For the first six months of 1902 the decree will not be applied in an absolute manner.

The courts of Lyons have recently rendered a decision interesting to patentees. By the law of 1844 the person who has obtained a patent must work his invention in France within two years after the date of patent or he will lose his rights.

The courts have decided that the working must be real, and that publicity due to the cession of the patent to another party is not sufficient.

Letters From Practical Men.

Kodak Pictures as Records of Miscellaneous Jobs.

Editor American Machinist:

Some years ago you published a very interesting article on "Shop Photography," contributed, I think, by Mr. W. H. Sargent, whose fine equipment for this work I had the pleasure of examining not long since. While my own photograph work in connection with the shop has been in quite another direction and would be of little or no value in a shop building standard machines only, it has proven so useful in special work on a limited scale that I think many small shops might adopt a similar scheme to advantage, especially those where no regular draftsman is employed. I am not recommending this "system" as being equal to regular drawing-room practice, but it is vastly better than nothing, and to the uneducated eye these little photographs show the assembled machine or its parts much better than the draftsman can do by plan and elevation; and perspective is out of the question in most cases.

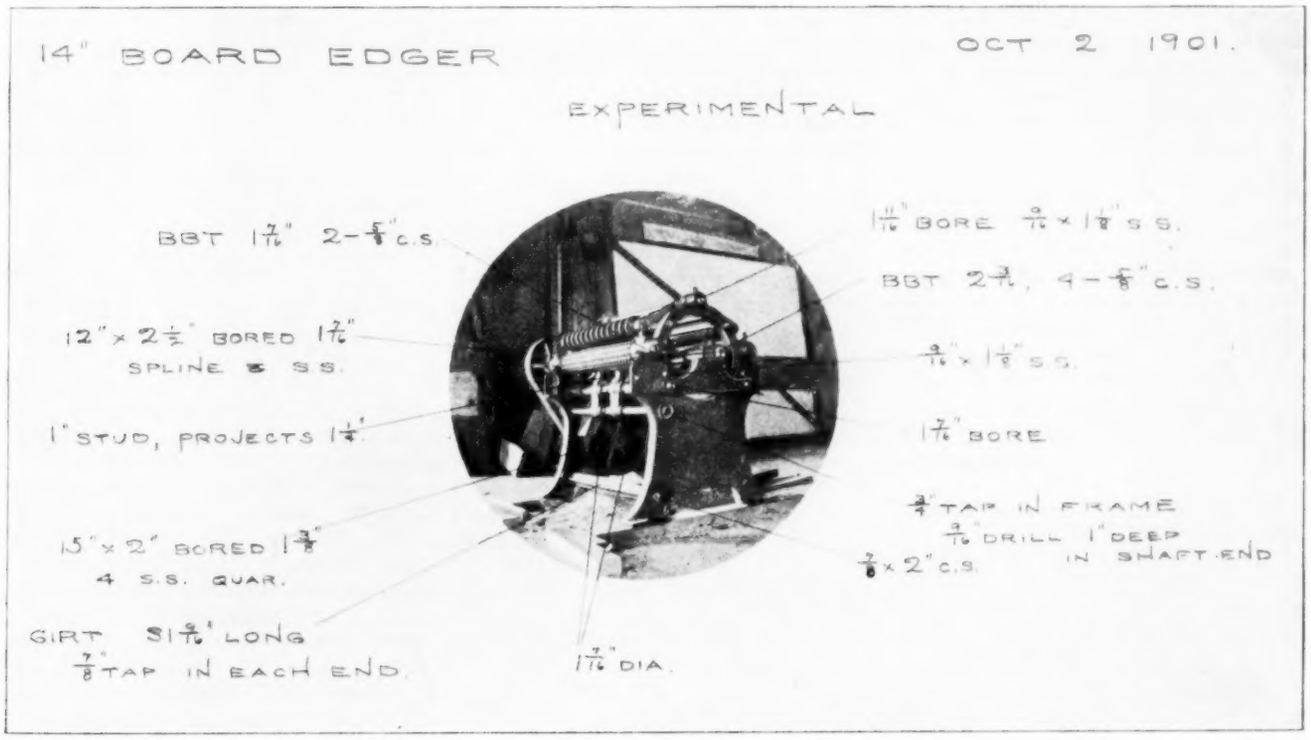
Even where there are very complete detail drawings of a machine these photographs help the shop hands, as not all have the faculty of making a flat drawing stand out from the paper as it does to the draftsman, while the photograph is a sort of universal language which all can understand.

In these days of snapshots and celluloid films there are few shops without one camera fiend on the payroll, and as all my work has been done with a pocket Kodak, making pictures only 3½x3½ inches, few of them will not be as well equipped for shop work as I am. All the special apparatus needed is a lump of chalk and a couple of cheap screens, and a few trials will give one a good idea of the best angles to show up a machine to advantage. If some important detail is concealed by the frame it can be removed and taken separately or grouped with other small parts.

Use the chalk liberally on corners, pulley rims, gear teeth, bolt heads, etc., and these will show up sharp in the negative, even if located in shadow. There are special developers for giving sharp line effects that might be a good thing, but I have had very good success with the ordinary camera supplies.

Mount the print on a sheet of white cardboard of a size large enough to insure liberal margins, and from each part desired run a fine line into the margin and there write the dimension and any other information that will help in construction. Set-screws, drilled or tapped holes, babbitted bearings, pulley sizes, gear dimensions, etc., can all be shown in good shape by anyone, and if the machinist has a fair idea of what a drawing should be he will have no trouble in dimensioning the width, depth and angle of a planed gibbed slide and other similar things. I have not found it practicable to locate turned fits on shafts, but the lathe sticks can be preserved for this purpose. With the best intentions and much care some dimension will be omitted, but this has been known to happen on very finely executed drawings, so it cannot be classed as a failing peculiar to this particular system.

So much for the system, now for its


14" BOARD EDGER
OCT 2 1901.
EXPERIMENTAL
BBT 1 7/16" 2-5/8" C.S.
12" x 2 1/2" BORED 1 7/16"
SPLINE & S.S.
1" STUD, PROJECTS 1 1/4"
15" x 2" BORED 1 3/8"
4 S.S. QUAR.
GIRT S1 9/16" LONG
7/8" TAP IN EACH END
1 7/16" DIA.
1 11/16" BORE 9/16 x 1 1/8" S.S.
BBT 2 3/4", 4-5/8" C.S.
9/16" x 1 1/8" S.S.
1 7/16" BORE
3/4" TAP IN FRAME
9/16" DRILL 1" DEEP
IN SHAFT END
7/8 x 2" C.S.

A KODAK RECORD PICTURE.

application: We have frequently had orders for small special machines where the customer supplied the patterns, but next to nothing in the way of information as to how to build them. Again, we have made drawings and patterns, but, the machine being experimental, so many changes were made in the course of construction that the drawings became useless for reference. This work is almost always done at job rates, and when the machine was done it would have been of no use to ask the customer to pay for a set of drawings, while the prospect of a duplicate order was too remote to warrant standing the expense ourselves. Often we did get the duplicate order, perhaps several years afterward, when everybody who helped build the first machine had forgotten all about it. As a "lump" price is generally asked for on the second machine, this would of necessity be quite a bit greater than if we had some record of finished dimensions.

Here is where the little pocket Kodak comes to the rescue, for the expense of making these prints and dimensioning them in the manner described is so insignificant that any shop can afford to make free use of them. If there is no drafting department they can be filed with the shop charges and the backs of the cards used to record weights, time, etc. In fact, the system is capable of extension in several directions, one of which would be for repairs, sending the customer a print and having him mark the part wanted and return it. Where castings have no particular name or number, it is often puzzling to know what part is wanted from the customer's description of it, but the photograph settles the question every time.

It may be news to some who have these small cameras that it is possible to make fine enlargements up to 10x12 inches with them by the bromide process, although the work requires some degree of skill and for shop use 3½x3½ inches is as good as a larger size if the negative is sharp and clear. If this article should be the means of inducing any who have never yet penetrated the fascinating mysteries of the dark room to give shop photography a trial, I want to say that there is no reason whatever why all should not succeed, but they must follow the directions accompanying the camera and follow them to the letter. There must be no "scant 32ds" or "shades over a 64th" or a flat failure will probably result. E. R. PLAISTED.

The Work of the Correspondence Schools.

Editor American Machinist:

The perusal of the criticism by "X. Y. Z.," at page 1405, Vol. 24, of the inability of correspondence schools to make draftsmen, has led to the following thoughts:

"X. Y. Z." seems to deplore the fact that certain young men have been so far misled by the glowing promises of some correspondence school to make draftsmen of those who take up their course, that they have proceeded to throw away time and money in a forlorn hope of being made into something.

There is no doubt that some of these schools, in their desire to increase their membership, promise too much. Of the methods of many of these I know nothing; of one or two I have some personal knowledge. One which I have in mind states that a young man desiring to fit himself for a draftsman's position, can do so much better by means of their course than by starting as an apprentice, giving as the reason the limited time which a busy chief draftsman has for instructing an apprentice, without which instruction his progress is necessarily slow and unsatisfactory. Of the mechanical engineering course, they say that they do not claim to fit a man to be a mechanical engineer, nor do they give a diploma to that effect, but they do claim to enable him to acquire a good practical foundation for such a profession, and also that he will be well enough advanced along mechanical lines to enable him to read text books understandingly.

The school is yet to be found, be it correspondence, applied science, manual training or any other kind, that can *"make a man anything."* Into this, as into many other problems, enters that factor of which we hear so much in these days, "the factor of the personal equation."

To the young man who has allowed days, months and years to slip by unheeded, in which he should have been studying and otherwise fitting himself for his life-work, but who finally awakens to the fact that without this knowledge he is forever behind in the race—to such an one comes the correspondence school with its practical course and its graded instruction offering, perhaps, the only solution to his dilemma.

Correspondence schools are not conducted on philanthropic principles entirely. They are business institutions, and their purpose is to make money. The most prominent ones have their agents in all the cities and large towns. An agent is not always careful as to what he promises when he has a commission in view, and the benefits to be derived from a course of this kind are enlarged upon and presented in glowing colors to the prospective student. In consequence of this he thinks only of the larger salary which he is to earn, the advancement which is to come when he has finished his course, and not of the many evenings after a hard day's work that are to be spent in more hard work, the mornings that he must arise an hour earlier than usual, the moments that must be snatched at the noon hour or on the street car, and many other sacrifices which he must learn to make if he ever expects to reach the prize which is held up to his longing gaze.

"Success means sacrifice." Caprice must give way to capacity; leisure to labor; dissipation to self-discipline. To do this is not easy; but nothing that is worth having is lightly won.

As to "the prodding and pushing effects," the world is full of them. There are not many of us who would work as hard or as constantly as we do, were it not for the necessity, the ambition, the love for family; one or all of which keep us at it until finally we come to love the work for its own sake. To the most of us this does not come until later in life, especially if we have not chosen our work wisely, and in accordance with the faculties and talents with which the very least of us have been endowed S. B.

Splitting the Foreman—Instructions to Workmen.

Editor American Machinist:

Your correspondent Eben Bones, who writes on the management of foremen, at page 99, touches on a subject that is somewhat neglected by the advocates of the splitting-the-foreman system. I mean the measurement of the man at the tool. I note some varieties from his enumeration: The dyspeptic, sharp-tempered, the jovial and familiar, the sneaking and suspicious, the fussy and worried, the lazy and careless, and last—though I beg to differ from him as to its rareness—the dignified and intelligent class. I know of no slide-rule that will estimate the value of this very important factor in shop management. Slide rules are being made to suit the different types of machines with the probable intention of leaving the man at the tool to be estimated mentally by the person operating the slide-rule. I do not wish to appear as an opponent of the splitting-the-foreman system, for, in a general way, I think it is all right; for I think the supply of efficient foremen is not equal to the demand. I agree with Mr. Swift that there is no scarcity of men who are able to draw big salaries, but I am of opinion that there is a scarcity of men who are able to earn them, and I don't think I have been hypnotized either. I am encouraged in this belief by the fact that I arrived late at the meeting of Mechanical Engineers. By the way, Mr. Swift assures us that he is no pessimist, and yet I have reread his article to try and determine which of the three birds—the hypnotist, the system or the Mechanical Engineers—he meant to kill the deadest. But to be serious, a large part of Mr. Swift's plaint is my own, namely, that the highest efficiency will only be obtained where the ability of the machinist is recognized and utilized.

I do not mean that the system will be a complete failure if the machinist is ignored, and it is hardly possible that the two methods, one of ignoring and the other of recognizing, can be run side by side for comparative purposes. Neither can one be tried this year and the other next. It seems to me, therefore, that this is a matter for the management to regulate, and to be successful it must be done with rigid impartiality. Let the men once understand that their rights will be safe-

guarded, and they will have more time and energy at their employer's service. After a piece-work price has once been fixed, let it be as unalterable as the laws of the Medes and Persians, and a man will know it will not work him harm to do a job in the least possible time. If by extra exertion he is able to earn a larger wage, his employer has profited also, for it generally happens that the machine is rated higher than the man, and in some cases many times higher; so that whenever the man doubles his earnings the profits by the machine have increased in nearly the same proportion. Let there be no favorites, but let every man understand that the shop is run for business purposes and not for charity. Let the sucker realize that he cannot pull the wool over the eyes of the management and get credit for something another man has suggested. There is the fellow who is always industrious when the boss is in sight or always making a great noise when he is within hearing, who is a very cunning fellow, and the boss must have his wits about him to get his measure, as any recognition given to such shifty methods has a discouraging effect on the good men in the shop.

There are those in authority who say it does not matter what the man thinks or feels; "we give him full instructions how to do the work and we pay him for doing it." At the time I heard this I was forced to conclude that it was due to a limited knowledge of the man at the tool, a knowledge which can only be gained by donning the overalls and going through the school that graduated him. A good drawing will have all dimensions for the finished article, and possibly a few notes about different kinds of fits, etc.; then the job ticket may have some further information about what tools must be used, the cutting speed expert and the feed expert give their instructions, but the job is not started yet. Suppose it is a planer job and ten or twelve rather light castings have to be clamped to the table. The setting of these pieces may take twice as long as the time required for the cutting, and they must be so clamped that they are not distorted, or they will all be spoiled, which work takes much time and involves great risk of loss, and for it there are no instructions. Surely the being who can supply the required knowledge must be of some account. To supply all such information would mean a whole book with each job, and to compile such a book would be beyond the ability of 95 per cent. of the draftsmen. It would take a bright man a long time to put into book form all the useful knowledge that a good machinist possesses, and to get him to make full use of it for the benefit and advantage of his employer must be one of the faculties of the successful foreman.

JOSEPH DYSART.

Rail Clips and Stops for Crane Runways.

Editor American Machinist:

I send herewith sketches of what I consider superior as well as cheap forms of rail clips and stops.

Fig. 1 shows the clips in position and Fig. 2 shows details of same for a 100-pound rail. It will be noted that the hight of clip C_1, Fig. 2, is 3-16 inch less than that of C_2. This is to allow the strip A, Fig. 1, to be placed under C_1 and, running the full length of the crane girder, prevent the rail spreading.

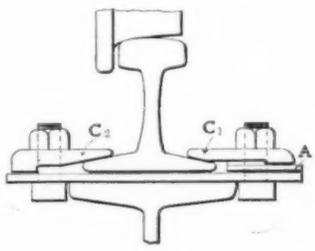


Fig. 1

RAIL CLIPS PROVIDING FOR ADJUSTMENT OF RAILS ON RUNWAY.

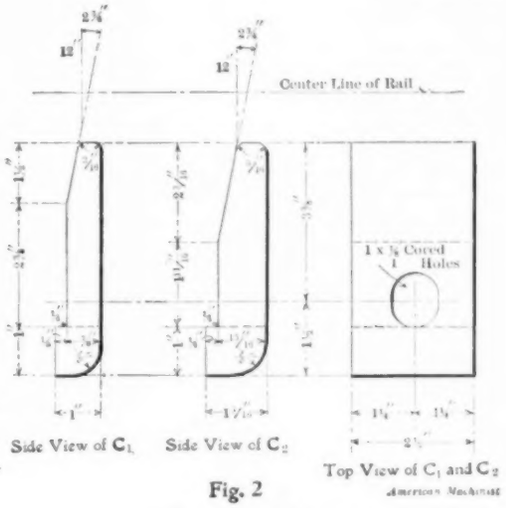


Fig. 2

DETAILS OF RAIL CLIPS.

This construction is superior to dowel pins spaced at intervals beside the rail, because it cannot work loose, while dowel pins may. It is also obviously much cheaper, and for the same results requires less care in construction.

Fig. 3 shows an end stop for a 150-pound rail. This construction is better than the curved-up rail and bracket often used, because, in case the crane runway is to be extended, as is often required, it is only necessary to unbolt the stop and move it to the end of the extended runway. In the case of the turned-up rail and bracket, the end rail length must be taken up and moved with the bracket to the new runway end. In addition to this disadvantage in providing for extensions, this stop is more expensive to make. Either form can be made strong enough.

F. D. BUFFUM.

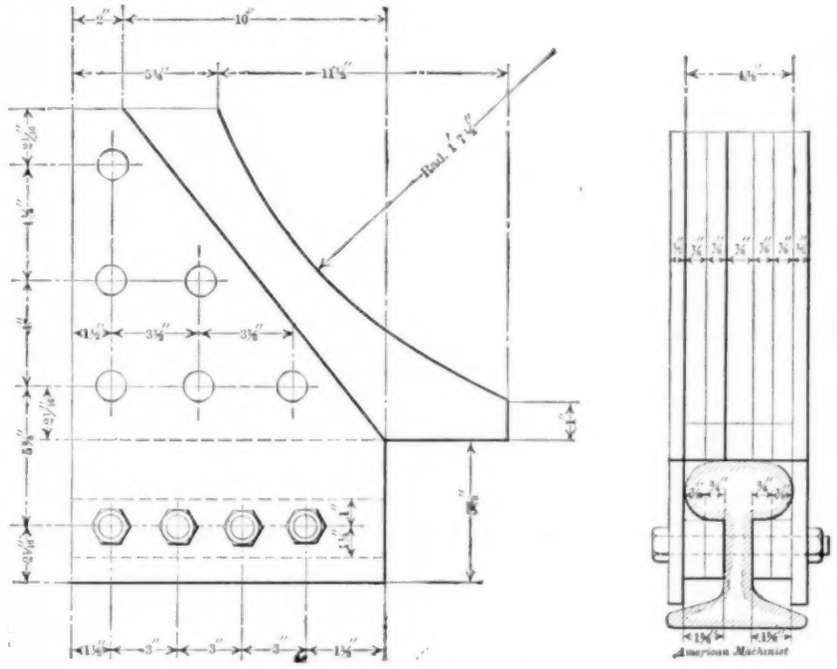


FIG. 3. END STOPS FOR CRANE RAILS.

Mr. Taylor and His Methods.

Editor American Machinist:

I was very much interested indeed in Tecumseh Swift's article on "Splitting Up a Foreman," published at page 23.

Though I have had exceptional opportunities to observe, ponder and inwardly digest the methods and results of Mr. Taylor's work, I feel comparatively at sea on the subject, and know that I and hosts of others could get the greatest help from

the thorough analysis of the Taylor principles of shop management as laid down in his well-known paper before the American Society of Mechanical Engineers and the recent paper before the same society by Mr. Gantt.

I believe that Mr. Taylor acknowledges no limitations to the application of his methods in machine-shop work. So far as I know, they have not yet been introduced into any shop except those in which the operations which cover the bulk of the work are comparatively few in kind and simple in nature. I do not think he ever actually tackled such a proposition as a general machine shop, but I am very sure that he would not for an instant admit the slightest reason why his method should be less effective there than in Midvale or Bethlehem. I know of no place in which he has failed to accomplish considerable economies when allowed a free hand, but whether the reason he has not always been allowed a free hand has been timidity on the part of the management or the belief in the minds of those in a good position to see, and, having everything at stake, that to allow him a free hand would have meant disaster, is hard to determine.

I think that no open-minded man who has been for any length of time in intimate contact with Mr. Taylor questions his possession of ability, personal force and fixedness of purpose to a remarkable degree. I do not think his radical suggestions have ever been discussed in the thorough way they deserve. Some men of long practical experience have gotten up in the Mechanical Engineers' meetings and ridiculed his whole scheme, cast it lightly aside as impracticable and absurd, while large shops have been going ahead and multiplying rates of production sometimes three, four and in the case of very important single tools ten to twelve fold over what the men in charge had gotten out of them before. Yet, although this fact cannot be questioned, the management under whose eyes it has been done have apparently lost interest in the work when only fairly started. Other men have been carried away by Mr. Taylor's principles and reports and look upon him as the herald of a new era.

Where does the truth lie? Is not the question a big enough one to justify thought and discussion by the best mechanical minds? I believe that he has accomplished what he claims to have accomplished (some of his most striking results I have personal knowledge of), but are they unquestionably worth the price, and can they be attained and maintained under conditions possible of realization in the average manufacturing establishment?

If you will open this subject to discussion and get the right men to enter into it thoughtfully and seriously, I believe that it would be of more interest and value to the people for whose benefit your paper is published than any other single subject you could select. While I have some ideas on the subject, I have been unable to reach a conclusion, perhaps because I have had a closer view of the particular work referred to than most men, but have neither the long experience on old lines to lead me to scoff at as impossible what I have seen accomplished under my own eyes, nor on the other hand have I been long enough "under the influence" to think that a complete overturning of every established principle is all right, on the strength of a particular showing. Will not establishment charges, where a large variety of work is done, be increased by this system? Can the human, or at least American, element of demanding some opportunity for individual thought and freedom of action on the part of the workingman be ignored? The training of men with wide knowledge of machine-shop practice (most essential in the rate-setting department under Mr. Taylor's system) is apparently done away with. Those who are to tell the men in the shop how to do things are removed from the place where the things are done, and may they not thus become like barnyard fowl, which, through not using their power of flight, lose it?

Much, too, depends on the point of the tool. Has steel manufacturing and tempering reached the point where that reliance can be placed on the tool lasting just so long at a given speed, as is demanded by this system? Can one predict the resistance to cutting of the metal being worked in the average machine shop—with any approach to the accuracy required by the differential price system—if very great differences in earnings of equal men are to be avoided? Taking men as they are, and considering the great difficulty of getting reasonably good foremen and leaders in the shop, can anything like enough men be obtained to set the rates and keep the work going under Mr. Taylor's system after the little all aroundness that now exists is taken out of the trade? Would the sort of man who is willing to settle down as speed boss do for a speed boss? Would the sort man who is willing to go into an office and set rates do as a rate setter?

I have set the riddle. Can you give me the answer? SPHINX.

We have referred to the fact that the St. Louis Exposition power plant is to be made an example of smokeless combustion and we learn that Prof. C. H. Benjamin, an account of whose work on that line in the city of Cleveland we gave at page 131, has been called in consultation with the Exposition management on this matter.

A steam exhaust pipe had its valve blown out one day last week at the Seating Company, and had it not been for the rags that pack the machinery, the machinist at work would have been seriously scalded.—*A Canadian Paper.*

The Opinions of Machinery Manufacturers on Reciprocity and Foreign Trade.

Some time ago we sent the circular letter reprinted below to a large number of manufacturers of machinery. We selected particularly builders of machine tools, because these have during the last five or six years been especially active in developing foreign trade and have been exercising the most profound influence upon industrial conditions abroad, while at the same time they have had the opportunity and the disposition to acquire ideas of value to them in pushing foreign trade. The circular letter we sent out is as follows:

TO THE MANUFACTURERS OF MACHINERY IN AMERICA.

"We have received a number of letters giving the views of manufacturers on our foreign machinery trade, reciprocity, the tariff, etc., and it has occurred to us that it would serve a useful purpose if there could be a general interchange of opinion on these subjects. We ask you, therefore, to give us an expression of your views.

"Whatever these views may be we will print them.

"Practically every advertiser in the AMERICAN MACHINIST is interested in the foreign machinery trade. Those who do not themselves do a considerable foreign business sell a portion of their product to others who use it in making things that go abroad.

"We would particularly like to have an expression of opinion from you regarding the following words spoken by the late President McKinley in his last public address at Buffalo:

" 'We must not repose in fancied security that we can forever sell everything and buy little or nothing. If such a thing were possible it would not be best for us or for those with whom we deal. . . . The period of exclusiveness is past. The expansion of our trade and commerce is the pressing problem. Commercial wars are unprofitable.'

"If you agree with this view of the case we would like to know what you think is the best way of doing something about it. If you do not agree we shall be equally pleased to have your views and to know what in your opinion ought to be done.

"Do you need a protective tariff in your own particular trade?

"Do you think the present high tariff has a tendency to retard foreign trade?

"Would free raw materials allow you to produce your product cheaper?

"Do you think that free raw materials would tend to keep the prices of such materials more uniform?

"Do you know of any country where workmen in any line do more for a dollar in pay than they do in the United States?

"Questions such as these are certain to be prominent in the near future. It is important to the machinery interests of the country that their welfare and their rights should be considered.

"A general expression of opinion such as we ask will, we hope, help in this important work.

"As it is probably better that this expression should be published as soon as practicable we specially request that you give us your views as soon as convenient.

"AMERICAN MACHINIST."

We have received about seventy replies to this letter, and shall print them in alphabetical order—as many as we can find room for each week, until all have appeared:

The Acme Machinery Company, manufacturers of bolt, nut and special machinery, Cleveland, O., say:

"It seems to us that when our late President McKinley stated, 'We must not repose in fancied security that we can forever sell everything and buy little or nothing,' he was but putting in felicitous words what all merchants and manufacturers recognize as a self-evident proposition. It seems to us, however, that those who discuss this lay altogether too much weight on their assertion that the foreign buyer does not like our tariff policy, and therefore he will not buy of us. We think he will buy where he can get the most for his money, all things being equal. We think the true inwardness of our late President's proposition is, that if the present trade balance of the United States should continue, it would disturb the equilibrium of the world, and so, of course, 'we *cannot* sell everything and buy little or nothing.' Consequently, we believe that a wise legislation that would secure to us the benefit of reciprocity in foreign dealings would be a good thing.

"We will answer your questions in the order in which you ask them:

"First—'Do you need a protective tariff in your own particular trade?' Frankly, we do not know. We never operated under anything but a protective tariff. In view of the success of the American manufacturer generally, it would seem to require a good deal of courage for one to say that he did not believe in a protective tariff for his own particular trade.

"Second—'Do you think the present high tariff has a tendency to retard foreign trade?' Not from the sentimental side; that is, the reason usually given for a belief that it does retard trade is that the foreigner will not buy from a country that does not buy from him. We think he will buy from the one that sells to him the cheapest and the best, but we do think it will retard trade eventually from the reason given by our late President.

"Third—'Would free raw materials allow you to produce your product cheaper?' Probably not much because in the manufacture of fine tools, material only figures for from 10 to 25 per cent. of the total cost. A little gain in that would not amount to much. It is for this reason that some of our splendid machine tools are made away up in the valleys of New England, where everything has to be carted in and out again. A little difference in the cost of the raw material does not "cut any ice," as the phrase goes.

"Fourth—'Do you think that free raw materials would tend to keep the prices of such materials more uniform?' Who knows?

"Fifth—'Do you know of any country where workmen in any line do more for a dollar in pay than they do in the United States?' No, certainly not. Our own conviction is that the reason this is so is because there is some hope for the American workmen, and we cannot help but feel that part of this is due to the policy of protection."

The Adams Company, Dubuque, Iowa, write:

"'Do you need a protective tariff in your own particular trade?' No.

"'Do you think the present high tariff has a tendency to retard foreign trade?' Yes.

"'Would free raw materials allow you to produce your product cheaper?' Yes.

"'Do you think that free raw materials would tend to keep the prices of such materials more uniform?' Yes.

"'Do you know of any country where workmen in any line do more for a dollar in pay than they do in the United States?' No."

Among the letters we had previously received pertaining to this subject was one from G. P. Altenberg, of Cincinnati, who for some years past has been looking after the foreign business of the Fay-Egan Company, who are very large builders of wood-working machinery. Though his letter was of course not written in reply to ours, it shows what he thinks of the situation as a result of wide experience abroad. It is as follows:

"During the past two or three years American factories have been very busy with both domestic and foreign orders. Many manufacturers, finding themselves unable to supply the increased domestic and at the same time the large foreign demand, have gradually added to their equipment, until to-day the productive capacity of their works is much larger than a few years ago.

"Now a great trade depression has spread almost over the entire continent of Europe. As if this were not enough, the United States Treasury Department has entered upon a destructive tariff war with Russia, the largest and most promising foreign field for the sale of American manufactures. Large quantities of machine tools, wood-working machinery and other manufactures were formerly exported to that country, but since the new Russian retaliatory duty of $4.77 per 100 pounds has gone into effect, this trade has practically ceased. The American must now pay over 57 per cent. higher rate of duty, besides shipping his goods from 5,000 to 6,000 miles farther than the Germans, who copy and imitate all things American.

"In shipping to France, America pays the maximum duty on all manufactures. On machine tools this is from 33⅓ to 50 per cent. higher than that charged Europeans.

"Germany is now preparing to check American imports into that country, because America seeks to sell her products in German markets, while closing her own doors to imports by a prohibitive tariff.

"The exceedingly hard times from which Europe is now suffering, together with the stopping of shipments to Russia, has greatly diminished the export of American machinery. Should there be any decrease in the domestic demand, our manufacturers will find it exceedingly difficult to keep their enlarged works employed.

"While times are still prosperous America should turn her attention to a rearrangement of her tariff and enter on broad and liberal lines into reciprocal trade relations with her foreign customers.

"There is scarcely an article which cannot to-day be produced better and cheaper in this country than abroad.

"As Americans go to foreign countries and sell their products in the face of home manufacturers there, paying the long freight and duty, why should they be afraid to let those manufacturers come here and try to get an order once in a while. Foreigners will not permit Americans to longer usurp their markets without receiving some privileges in return.

"Why, for instance, should England admit American wood and metal working machinery free of duty, when we charge 45 per cent. duty on anything in those lines that she chances to offer us? If she can produce it better or cheaper than we can, her example, as exemplified by the imports, will sooner or later stimulate some of our restless, enterprising spirits to devise a way or means of manufacturing it even better and cheaper; not cheaper because of lower wages for labor, but by devising better methods or better machines to do the work."

Capt. E. P. Reichhelm, replying for the American Gas Furnace Company, New York, large manufacturers of gas furnaces for industrial purposes, says:

"Complying with your request for my views on the words you quote from President McKinley's last address and on the subject of 'Protective Tariff and Reciprocity,' I beg leave to say, in the first place, that, in my judgment, the whole address, and the quoted words in particular, outline the future economic policy which we must follow as a nation to insure our future prosperity and happiness.

"I also thoroughly agree with you that it will 'serve a useful purpose' to induce

a general expression of opinion on these subjects, not from statesmen, lawyers and politicians, but from your clientage of practical men, who, as a class, must be credited by their fellow citizens with the possession of a well-developed common sense and the ability to use it effectively in solving questions vitally affecting their own interests.

"The underlying principles of national and business economy differ in magnitude but not in kind. It seems to me that the sentence from President McKinley's address which you quote forms a complete platform upon which we can all stand with both feet, and in connection with it I take the liberty to quote another martyred President, James A. Garfield, who in a speech delivered in the House of Representatives, while he was chairman of the Committee on Ways and Means, and during a debate on the tariff then pending, said: 'I am for that kind of protection which leads ultimately to free trade,' and this has been for over twenty years my own position with reference to the protective tariff.

"Protection is right. It has done successful work in developing the unequalled natural resources of our country. It remains right as long as a sharp competition with foreign goods would discourage American enterprise and prevent the payment of American wages to American workmen. Protection has enabled us to go through our apprenticeship in hundreds of new industries without starving and without discomfort. It has stimulated capital and labor in unexampled exertions in the conquest of new fields of industry into which we entered, instead of remaining farmers and cattle breeders. It has enabled us to live during the infancy of our industries, and live well, while we learned the business.

"But any industry developed to a point where it successfully competes with the whole world while paying American wages to American workmen, should at once be declared master of the art, and its product placed on the free list If this is not done, protection becomes a fraud upon the whole people, a false pretense and a means of making the people pay arbitrary prices, regardless of intrinsic value, which are imposed by the makers of goods who combine and fix prices anywhere up to the limit where foreign competition can pay duty nd still compete. This we know as a matter of fact to be the case at the present time in many industries, and their claim to protection now has become an evil, which in the common interest should be removed.

"We are confronted with a surplus. I do not object to surpluses—at least, not in my own pocket; but when the surplus accumulates in Uncle Sam's strong box, much as I love him, I object to it. There the surplus becomes useless. To it each one of us must contribute, whether he knows it or not, by paying taxes. The money is withdrawn from circulation and becomes dead and useless, while it should stimulate the industries of the country by its circulation.

"A surplus derived from taxation I consider nothing else than a national scandal. Therefore taxes should be reduced. First of all, the internal revenue taxes imposed for defraying the expenses of the late war. Then take down the tariff wall on steel and iron, because this 'infant industry' has grown to full manhood, and is in fact a monster and a prodigy. If some branches of this industry are still in need of soothing syrup or any other artificial stimulus, let them prove their needs before a Tariff Commission, and give them whatever protection they still may need if they make an honest statement of the facts, and do not ask it merely to enable them to form trusts and combinations with the power of taxing the whole people, in place of having the taxing done by the government.

"A Tariff Commission is my idea. It should have the 'power to send for persons and papers,' to sit as judges do, sworn to render a verdict in every case brought before them according to ascertained facts, and with reference to this simple question, 'Do you need protection?' and 'On what ground of public good do you claim it?'

"Bearing in mind that the greatest good to the greatest number is the sole object of the government, it stands to reason that no individual can be rightly enriched at the expense of the whole people. Protection is right when the national welfare is increased by it, its industries diversified and the country made more and more independent of other nations in what our advancing civilization needs. It is wrong when it enriches a few at the expense of the many, and has the virtual effect of transferring the taxing power of the gov rnment to private individuals or corporations.

"Answering your several other questions concisely, I would say in the first place that the American Gas Furnace Company needs no protection, except what it may be entitled to under our patent laws, and even this is of doubtful value and not absolutely necessary for its prosperity.

"The present tariff retards foreign trade.

"Free raw materials would enable us to produce cheaper and sell more.

"That in no country under the sun does a mechanic do more or better work for a dollar than in ours, has been demonstrated too often to need further proofs, and permit me to add that in no country is he under the direction of a harder worked set of employers."

The American Tool & Machine Company, 109 Beach street, Boston, Mass., manufacturers of machine tools, oil extractors, etc., say:

"We are perfectly satisfied to let the tariff remain as it is. We would not care to advocate any changes in the same at the present time."

Baker Brothers, manufacturers of improved iron-working and wood-working machinery, Toledo, O., say:

"We agree fully with the sentiments expressed by the late President McKinley in his Buffalo speech in reference to reciprocity. While we believe in ample protection to American industries, we believe the time has arrived where some concessions will have to be made to foreign countries to retain the trade we have with them, and we believe this can be done without injury to the American industries. We, like other manufacturers, have been more or less handicapped by import duties of other countries; and this is more especially true in reference to Canada, where the duty is almost prohibitive."

The B. F. Barnes Company, manufacturers of machine tools, upright drills and lathes, Rockford, Ill., say:

"We agree fully with the view of the case presented by President McKinley, and are strongly of the opinion that our national legislation should be directed so as to bring about the results which he indicated as being desirable and necessary

"We believe that the industrial development of the United States has reached a point where a tariff as high as the one now in force is not only unnecessary, but that it is a hindrance to the extension of our foreign trade. Taking up your specific questions, we would state:

"First—In our own particular trade (machine tools) we do not need a protective tariff.

"Second—We think the present high tariff has a tendency to retard foreign trade, in that it tends to create a feeling of hostility in other countries and provokes retaliatory action, the natural result being to restrict business relations between this and other countries and to thereby diminish the volume of our export trade.

"Third—We think free raw materials might to a certain extent allow us to produce our product cheaper.

"Fourth—We are of the opinion that free raw materials would tend to keep the prices of such materials more uniform.

"Fifth—We do not know of any country where workmen in any line do more for a dollar in pay than they do in the United States. In other words, we believe the workmen of the United States have a higher degree of efficiency than those of any other country.

"The industrial development of this country has reached that point where our manufactured products cannot be wholly absorbed by our own people; consequently we must find foreign markets for a portion of our output if our manufacturing industries are to run at their full capacity.

It is therefore necessary that we should cultivate friendly business relations with other countries, particularly with those whose purchasing ability is the greatest and whose wants are the most diversified. Our national legislation should not seek to erect barriers against our dealings with other countries, but to lower existing barriers as much as possible. To this end we think the reciprocity treaties now pending should be made effective, and we are of the opinion that our present tariff could wisely be trimmed down (particularly in those cases where the existing rates of duty practically prohibit importations), thereby making it possible for great industrial and financial combines to control prices.

"The continued activity and healthy condition of the home market will be promoted by the extension of our foreign trade, and the United States is giving constant evidence of its ability to meet the competition of other countries.

"All trade, however, presupposes mutual advantage, and, as President McKinley said, 'We must not repose in fancied security that we can forever sell everything and buy little or nothing.' If it is profitable for men in Illinois to trade with men in Massachusetts or California, there is no reason why it should not be equally advantageous for men in Illinois to trade with men in England, France or any other part of the world."

The Beaman & Smith Company, machine tools, boring and milling machines, Providence, R. I., say:

"While we have had quite a number of orders from abroad, we do not feel our business in that direction has been sufficiently extensive to enable us to offer suggestions that would be of any particular value. We believe in the spirit expressed by President McKinley in his speech at Buffalo."

The Betts Machine Company, makers of metal-working machine tools, Wilmington, Del., say:

"We heartily concur in the words of President McKinley in his last public address, at Buffalo. We think the best way to hold and increase our foreign trade is by reciprocal treaties; great care, however, being taken in their promulgation not to injure those of our industries still in the need of suitable protection.

"In our line of manufacture we do not need the protective tariff, and to have it removed would probably result in an increased trade for us in foreign markets, most especially with those nations whose goods being now kept out of this country by the duty, cause their people to have feelings of resentment against us.

"While we are thorough believers in the policy of protection for such industries as need it, yet is it entirely safe to rest in the 'fancied security' which this policy has brought us, and which to-day sees every American industry teeming with business? Is it not better, even in the most prosperous times, to look a little ahead, and not be satisfied with the let-well-enough-alone policy? For the day may come (and it has been here before) when we will welcome any outlet for our country's product."

The Binsse Machine Company, Newark, N. J., manufacturers of horizontal boring machines, say:

"The subject will be clear once we pierce the fog with which it has been enveloped. To drive away this obscurity, let us begin by the use of correct words in stating the case. We must understand clearly that ours is not a protective tariff at all. Germany, France and the continental nations of Europe all have protective tariffs. Ours is a *prohibitive* tariff, imposing duties with the intention of shutting off our market to all outside nations; and there is no nation in the world with a set of customs duties equal to ours.

"It is acknowledged that our land is by far the richest in natural resources and that we have besides in superabundance energy, skill and money. Then, why this swollen tariff?

"The cause is very simple, but also of such character that I firmly believe that nothing else but the danger of widespread financial disaster will nerve our people to throw off this oppression. Before me I have prices on some sizes of steel, ranging from 3½ to 4 cents per pound. To my certain knowledge this material can be produced and sold at good profit for 1 cent per pound. Hence come Carnegie and the numberless minor Carnegies. That is to say, the Dingley bill was designed not to protect American manufactures in general, but, by the suppression of outside competition, it was intended to protect extortion; to enable a few great interests to overcharge our nation, and to amass enormous wealth in a very short time. For example, there is a little article which enters into almost every detail of the household. In England it sells for a price which I shall designate by 3, and at that price pays an enormous profit. The English companies making this article pay about 40 per cent. dividends yearly. In our land, where is grown the raw material for this manufacture, it sells at a relative price of 5. That is, every household in this country is taxed to enrich the lucky producers of this little article. I am suppressing names to avoid personalities.

"This is the truth about the tariff. It is an instrument of oppression and extortion, not of protection. We re prosperous not by it, but *in spite of it;* and our prosperity, were the tariff reduced, would be such as the world has never seen before. A protective tariff, like that of Germany, would increase the working man's wages not less than 50 per cent.; that is, with his present wages he could buy 50 per cent. more, at least, than he does to-day.

"Just as the owners of silver mines resisted successfully all attempts to put our currency on a sound and scientific basis, and, on the contrary, brought us to the brink of ruin, so will the other great interests resist every attempt to put our tariff laws on a rational basis."

A Feature of the World's Iron Trade.

It is a singular feature of the iron trade of the world that the best markets, with rare exceptions, are those of the countries that are themselves largely engaged in producing the very things that they want to purchase, and do purchase, on a large scale. Until lately, no market was so good as that of the United States, and, despite the high tariff policy of the country, it still imports iron and steel to the value of over twelve million dollars a year. But the most singular feature of this manifestation is that the United Kingdom, which is the greatest exporter of iron and steel in nearly every form, is itself a larger importer of these metals than any other country in the world, and Great Britain is followed at a not very great distance by Germany, which is almost as large a producer of pig iron, and an even larger producer of steel. France is a considerable way behind Germany, and Belgium is a long way behind France, as an importer of iron and steel goods, which again bears an approximate relation to the extent of the output of these several countries.—*Iron and Coal Trades Review.*

The Humbug Again.

Editor American Machinist:

The *Southern Review of Commerce*, Fred Bradbury, purported editor, appears to have boundless confidence in its ability to gather in the shekels and to entertain something more than an impression that the Northern manufacturers are soft marks.

January 17 they addressed a letter to us, no doubt a duplicate of the one recently addressed to the Brown & Sharpe Company, and enclosing a write-up, "We Were Right," etc., which appears to be practically a verbatim copy of the write-up furnished Brown & Sharpe, except substituting our name and product.

We do not find either the *Southern Review of Commerce* or the Louisville Printing Company named in Dun's.

We have requested that they remove our name from their mailing list and address no more communications to us.

WILMARTH & MORMAN CO.,
L. T. WILMARTH, Pres.

The Austrian State Railroads have let contracts for 968 tons of cast-iron rail chairs, which have been introduced quite recently. Nearly all will be furnished by one company, which offered them for $1.33 per 100 pounds.

AMERICAN MACHINIST

Published at 218 William St., New York, every Thursday by the

American Machinist Press.

[INCORPORATED.]

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

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Our Letters on Reciprocity and Foreign Machinery Trade.

We begin in this number the publication of a series of letters that are in some respects probably the most remarkable ever received by an editor for publication. These letters express the carefully formed views of men regarding a tariff law enacted avowedly in their interest. The views, especially the more outspoken and radical ones, are expressed by men who not only conduct extensive manufacturing operations here, but who have been abroad, have met and talked with their foreign customers, and know as much of the situation as it can be hoped that such a body of men ever will know. They are not engaged in a political campaign, but are carrying on business to make money, and all they ask is that they be given a fair chance to do that. The letters will follow in each issue as fast as we can find room for them, and they will be well worth reading.

Presentation of the Carnegie Engineering Laboratory at Stevens Institute.

For many years Andrew Carnegie has been on the board of trustees of Stevens Institute of Technology, Hoboken, N. J., and it is natural that, in the extensive distribution of wealth he is now making, this school should come in for a share. While the Alumni Association was occupied in raising $50,000 in dribblets for a much-needed additional building, Mr. Carnegie stepped in with a like sum for a similar purpose, and his building is the first to be erected. About the time Mr. Carnegie's donation was made, occurred the bulge in structural materials, so that the amount at first allotted was no longer adequate, and the alumni building was postponed; but Mr. Carnegie said that there should be no delay in his, and accordingly added $15,000 to meet the increased expense.

The ceremony of presenting the Carnegie laboratory to the trustees of the Institute took place in the top story of that building, the evening of February 6. It was combined with the midwinter meeting of the Alumni Association. There was present an unusually large attendance of graduates besides a number of invited guests.

The ceremonies were brief and simple. After a short business session of the association, Dr. Henry Morton, president of the Institute, called on Wm. S. Ackerman, M. E. (a graduate of '91), on behalf of Ackerman & Ross, the architects, to deliver the keys to Mr. Carnegie in order that he might present them to S. Bayard Dod, president of the board of trustees. Mr. Ackerman did so with a few well-chosen remarks, mentioning incidentally that there was no unexpended balance.

Mr. Carnegie then presented the keys, with a speech which was received with much applause. He was in high spirits and spoke fluently and entertainingly, with an air of entire and sincere unconsciousness that he was entitled to any credit for his gift, or that he had done anything remarkable.

In his remarks, after complimenting the architects upon the new building from the viewpoints both of art and utility, Mr. Carnegie said:

"Usually when I am brought out from my cage to perform my keeper has presented me with a timetable, a sort of program, telling me just when to roar, and just when other men are to be the lion, or the tiger. Here I am let loose with nothing of the kind. But I always like spontaneous, unknown, disconnected receptions like these, so you will pardon my mistakes, etc., when you know that I have been furnished with no schedule and am a lion broken loose with no keeper whatever. There is something charming in being allowed to say what you please.

"My trifling gift to Stevens was not a thing of chance. It was no whim, but it was conscientiously bestowed. I know what the Institute is doing, for in all my experience in manufacturing I have learned this thing above all others: bring brains and knowledge to your work, even in the smallest detail. I always followed that rule. Our firm was the first firm and I believe I was the first man who employed a chemist at a blast furnace in the United States. And, mind you, he had to be made in Germany. We paid him the enormous salary of $1,500 a year. But then that is as much as I got as general manager of the Pennsylvania Railroad."

These remarks were frequently interrupted by laughter. Mr. Carnegie then related how he was ridiculed for employing this German in spectacles at his iron works. He soon, however, got even with his critics. There was a particular ore which had a reputation behind it and which was supposed to contain between 60 and 70 per cent. of metal. But, no doubt for the reason that in course of time the mines had been dug down into a poorer earth than the first, analysis showed the ore to yield only forty-odd per cent. Mr. Carnegie adopted the policy of buying ore upon chemical analysis rather than by name.

"Ah! boys," said he, "there is something in a name. Let it always be your aim to get a name. No one suspects you then. Other manufacturers were buying ore by name; we got a richer and cheaper ore which had no name. You can charge a dollar more for a hat if it has a name. We made money by looking beneath the name."

Mr. Carnegie also cited a case in which he had secured a great advantage over his competitors through determining the amount of phosphorus in slag.

He sought further to emphasize the relation between technical education and success. He referred to a great English ironmaster who had told him: "Mr. Carnegie, it is not your superior ores nor your

great mills that impressed me most, but the class of young men you have in the iron industry here. We have no corresponding class in England." "Therefore," said Mr. Carnegie, "when your president [Dr. Morton] spoke to me about a laboratory, I felt that I owed more than a laboratory. I offered him this building. He made me feel quite at home and at my ease and accepted the offer."

After Mr. Carnegie had concluded his remarks and formally turned over the keys to Mr. Dod, who made a brief response Dr. Morton, on behalf of the Alumni Association, presented a return testimonial—a section of a rail from the first T-rail track, which was that of the Camden & Amboy road. This rail was made from the design and under the personal supervision of Robert L. Stevens, about 1831, at the works of Sir John Guest, in Wales. The sample is enclosed in a silver casket, with symbolic ornamentation, designed by A. D. Turner and made by Tiffany & Co. A preliminary description of the rail and casket was published in the AMERICAN MACHINIST, at page 575, Vol. 23, and the matter at that time attracted considerable attention in Wales as well as in the American technical press.

In acknowledging the gift, Mr. Carnegie said, in part: "To think that my name should figure on the same casket with Robert L. Stevens is an honor beyond all expectation, for among men none was of more value than he. In the list of geniuses that you can count on the fingers of two hands, no list is complete without the name of Robert L. Stevens. I had no inventive mind, simply a mind to use the inventions of others. I think a fit epitaph for me would be, 'Here lies a man who knew how to get around men much cleverer than himself.'"

Of course this was Mr. Carnegie's little joke, and it was duly laughed at by his audience and himself; though by garbling it somewhat it has been made to appear in some newspapers as a serious proposition.

After the exercises the meeting adjourned to a hall on the second floor of the building, where supper was served in a manner made as suggestive as possible of the industry from which Mr. Carnegie has made the money which paid for the building—that is to say, not practically suggestive, after the tin dinner-pail fashion, but ideally suggestive. On one of the tables was a model blast furnace about 4 feet high, which on being tapped yielded punch. There was an open hearth furnace which, when the door was raised, appeared red hot inside; this yielded fried oysters. There was a Bessemer converter which occasionally made a "blow," ejecting showers of sparks; it was charged with small cakes. Industrial railways fulfilled other timely functions; in sundry kegs were railroad spikes of bread and cake, while ice-cream was served in T-rail sections. These devices, we think, are attributable to the personal ingenuity of President Morton, and they were evidently very much enjoyed by the guest of honor, who enthused over them as a boy might have done, and repressed no exhibition of his high appreciation of the occasion and of the ingenious and appropriate arrangements.

On the first floor of the laboratory has recently been installed a 65 horse-power Allis-Corliss cross-compound engine, the gift of the Stevens family. The new boiler-house is Dr. Morton's contribution. He has many times shown his ability and readiness to sustain the institution after a manner that few college presidents can follow on a similar scale. Several portions of the equipment costing large sums have been his personal gifts.

Personal.

O. W. Russell has severed his connection as editor of *Power and Transmission* and as advertising manager of the Dodge Manufacturing Company, having formed a connection with the Pittsburgh (Pa.) Gage and Supply Company, in charge of advertising.

A "shop meeting" of employees of William Sellers & Co., Sixteenth and Hamilton streets, was held Saturday at noon, when John Sellers Bancroft, for sixteen years manager of the works, was presented with a beautiful tea set, with a mahogany chest. Mr. Bancroft has resigned to take a responsible position with the Lanston Monotype Company, and his fellow employees at the Sellers works wished to make his last day with them one of pleasant recollection to him. Complimentary addresses were made by Coleman Sellers, Jr.; William H. Thorne, Joseph Kimes, A. E. Outerbridge and Strickland L. Kneass, who presided, after which every one of the nearly 700 employees grasped the retiring chief's hand and wished him God speed in his new field. Mr. Bancroft entered the Sellers concern in 1861 as an apprentice, was made general foreman in 1866, admitted to the firm in 1873, and upon the incorporation, in 1885, was elected manager of the works and power plant.—*Philadelphia Ledger*, Feb. 3, 1902.

Obituary.

Ernest M. Parent, manager of the Pullman Car Shops, died February 2, forty-two years old. Mr. Parent was in charge of the company's shops at Detroit before he went to Pullman.

James T. Dill died in Brooklyn, February 1, eighty-one years old. Mr. Dill was a machinist and for many years and up to his death had conducted a pulley and shafting business in New York.

The name of Charles Parker, who died at Meriden, Conn., January 31, in his ninety-fourth year, is perhaps most familiar to the mechanics of these days through the well-known and widely distributed "Parker" vises. The story of Mr. Parker's life is a most interesting one, as that of a most successful and more or less typical New England manufacturer. He would seem to have been indebted as little as possible to the circumstances of his birth, as he was placed with a farmer when nine years old, and continued his farm life until he was eighteen, with, we may suppose, the usual opportunities of the country school at intervals. Then he was employed in casting buttons for a year or so, and after that he was making coffee mills. When he was twenty-one he got into business for himself, and at twenty-three he had bought an acre of land and built a small shop. Later a brother and another became partners and some business embarrassments followed, especially in connection with the general hard times around 1837. These, however, were survived, and Mr. Parker's business interests rapidly broadened. In 1844 he first used steam power, and was the first to manufacture plated spoons and forks and plated hollow ware in Meriden. The Charles Parker Company, which was formed in 1877, manufactures an extensive line of goods, among which are vises, coffee mills, wood screws, spoons, lamps, chandeliers, etc. Other concerns in which Mr. Parker was the principal owner are: Parker Brothers, manufacturers of the Parker gun; the Meriden Curtain Fixture Company, the largest manufacturers in the United States of shade rollers, curtains and fringes, and the Parker Clock Company. Mr. Parker was an untiring worker and retained his vigor to the last year of his life. A portrait of him in his ninetieth year might be taken as that of a man of sixty.

Commercial Review.

NEW YORK, Saturday, Feb. 8.

MR. RICH ON RUSSIAN CONDITIONS.

President Rich, of the Russian-American Export and Import Company, 120 Liberty street, New York, who has lately been on a five months' trip to Russia, sets forth very strongly the deplorable effects upon American machinery trade that have resulted from the tariff imbroglio. The imposition of retaliatory duties on many sorts of American machinery, etc., about a year ago was followed by similar measures directed at still further classes—bicycles, then typewriters, then sewing machines, and now there is an agitation to strike a blow at American harvesting and threshing machinery. Prominent businessmen of the Empire advocate such a course. In fact, the sentiment in Russia is, that the American policy is highly unfair and provocative of vigorous retaliation. On the other hand, if the United States were to adopt conciliatory measures, Mr. Rich believes that they would be responded to.

The crops throughout the greater part of Russia were so heavy last season that about 50 per cent. have been left lying

for want of implements with which to harvest them.

A prejudice exists against American agricultural engines in favor of the English and German ones, which are heavier. A portable engine of less than 800 or 900 pounds weight is regarded as too light.

American machine tools are of course practically excluded by the heavy duty. English and German are bought instead. Whereas Russian buyers might be willing to order an American lathe, even at a higher price than the cheap German machine, were it not for the discrimination in duty; yet when it comes to paying an extra duty of, say $500, the obstacle is generally insurmountable. In small tools the tariff does not cut such a figure, but four pounds is practically the limiting weight. General hardware, such as padlocks, is unfavorably affected and German products are making headway against American goods.

An American sewing machine company controlling works in Germany enjoys the advantage of sending its products into Russia subject only to the duty in force against Germany, and of course if Americans undertake to manufacture machinery in Russian territory they may avoid the duty. In engaging in such an enterprise, however, they encounter strong Russian prejudice and obstacles are imposed against them.

MR. BARNES ON AUSTRALASIAN AFFAIRS.

Albert J. Barnes, of the Whitman & Barnes Manufacturing Company, has just returned from a long trip through the British colonies of the Southern hemisphere. The company are manufacturers of twist drills, wrenches and other machinists' tools, besides which they make agricultural tools and mechanical rubber goods, rubber horseshoes, etc. For more than a year he has been traveling through Australasia and South Africa, the former region being visited twice during the time.

In conversation with a representative of this paper, Mr. Barnes bore testimony to the growth of the market in Australia and New Zealand for American tools and machinery. At present the chief competitors for this sort of trade are Great Britain, Germany and the United States. The machine tools that have been used are chiefly English. There is, however, no prejudice against those of American make, except from the fact that some which already have been purchased in this country have been found of rather an inferior quality, which is probably due to their having been ordered within a price limit. On the other hand, a recent purchase of an American drill press in New Zealand, by catalog, resulted in agreeable surprise on the part of the buyer. There is an excellent field for the sale of American machine tools, such as are adapted to small jobbing shops. Indeed, the prospects are thought to be excellent for a manufacturer who will devote some trouble and money to cultivating the Australian market for metal-working machinery. It is quality rather than price which cuts the figure down there.

The tariff in Australia is a protective one, and a new schedule has recently been promulgated. Under the old tariff mechanics' tools—that is, small tools—were on the free list, and it is understood that they are also free under the new. In New Zealand the duty on them is little or none, although there is a fairly high rate charged on machine tools, which are also dutiable in Australia. The Australasians have not yet acquired a resentment against the United States because of our tariff, for the reason that they have not yet been brought in sufficiently close relations to it. The line in which they would chiefly feel it, if at all, is that of wool. If some Australian, it is suggested, should come to America o sell woolen goods he would no doubt return with a tale of woe, which would help to open the eyes of his countrymen. Speaking of woolen goods, there are four large textile plants in New Zealand; underwear is manufactured in that country, and, in connection with the manufacture of cloth, clothing is made up. The advancement in textile manufacture is not quite so marked in Australia.

as a result in the decline in iron prices a year or so ago. At that time the quotations of the American product were such that it could be imported in Australia much cheaper than the English; in consequence orders for bar iron were placed in America. The specifications called for certain lengths, but in filling the orders uneven sizes were put in. An instance is cited in which payment was refused on this account. It is also stated—and Mr. Barnes thinks on good authority—that some of the bar iron was not bar iron at all, but mild steel. The buyers did not understand the use of this very well, and the matter has caused such adverse criticism that it is likely to constitute an obstacle to the American bar iron trade for some time to come.

In regard to the labor questions which are attracting so much attention both in New Zealand and in Australia, Mr. Barnes has derived the impression from the business men with whom he has conversed that industrial betterment is rather being overdone. The workmen are highly gratified, although they are asking for still greater privileges, but the manufacturers are not generally pleased. It appears that the laws in some cases are working a detriment to the workmen themselves.

MACHINERY, MACHINES, AND PARTS OF—	DECEMBER— 1900 Number.	DECEMBER— 1900 Dollars.	DECEMBER— 1901 Number.	DECEMBER— 1901 Dollars.	TWELVE MONTHS ENDING DECEMBER— 1899 Number.	1899 Dollars.	1900 Number.	1900 Dollars.	1901 Number.	1901 Dollars.
Cash Registers	1,309	107,663	778	67,440	.....	.....	.....	860,622	10,983	931,984
Electrical	.....	328,916	.....	358,480	.....	3,145,838	.....	5,286,224	.....	5,623,442
Laundry Machinery	.....	33,553	.....	41,094	.....	.....	.....	475,052	.....	517,842
Metal-working	.....	355,416	.....	325,361	.....	6,840,924	.....	6,210,594	.....	3,003,871
Printing Presses, and parts of	.....	158,100	.....	108,322	.....	1,037,644	.....	1,295,379	.....	799,535
Pumps and Pumping Machinery	.....	177,733	.....	187,549	.....	3,016,645	.....	2,750,312	.....	2,024,937
Sewing Machines, and parts of	.....	336,266	.....	276,658	.....	4,103,828	.....	4,510,221	.....	3,749,334
Shoe Machinery	.....	71,884	.....	97,853	.....	961,736	.....	1,023,929	.....	1,059,145
Steam Engines, and parts of—										
Fire	.....	.....	3	8,446	4	21,848	13	24,625	11	26,081
Locomotive	43	408,615	29	189,416	484	4,767,850	436	4,468,527	448	4,051,434
Stationary	77	111,600	79	92,181	872	494,939	1,273	873,509	1,231	861,864
Boilers and parts of Engines	.....	104,007	.....	149,985	.....	1,439,363	.....	1,855,398	.....	1,495,972
Typewriting Machines, and parts of	.....	232,047	.....	286,005	.....	2,776,363	.....	2,736,435	.....	2,937,762
All other Machinery, and parts of	.....	1,967,851	.....	1,605,693	.....	19,721,191	.....	23,852,046	.....	18,665,182

UNITED STATES EXPORTS OF MACHINERY OF DOMESTIC MANUFACTURE, INCLUDING THE CALENDAR YEAR 1901.

In electrical machinery, as is well known, the United States has furnished some large street railway equipments for Australian cities. Generally speaking, however, it appeared to Mr. Barnes that the German product had the call in some places, and the local impression seemed to be that German electrical machinery compared very favorably with American. In such lines as machine tools, however, the German product was viewed with suspicion. "Made in Germany" has a significance in Australia similar to that which it has in America. One instance of trade which does not reflect very favorably the methods of American exporters occurred

For instance, there is generally in the Australasian colonies a regulation specifying a minimum wage rate, below which no manufacturer can employ help. A regulation of this sort was recently going into effect in Victoria. As a result it became unprofitable to retain some of the older men who had been employed on low pay, and they lost or were likely to lose their jobs. Some of the manufacturers, indeed, are talking of abandoning their business because of the onerous conditions imposed and importing goods from abroad. It is to be noted, however, that even most of those who are opposed to the present labor laws are in favor of public ownership of rail-

ways, a policy which is being carried to still greater lengths than hitherto. The only remaining private railroad in New Zealand is now understood to be going into the hands of the government. The consequence of so much government ownership has been the incurment of heavy debts. New Zealand has borrowed largely in Great Britain and expended the money at home, so that her credit is now running low, although the country has for the last few years been very prosperous. The government administration of railways in the colonies does not appear to be marked by financial sagacity in every case. It seems to satisfy the authorities to see a margin of profit in receipts over running expenses, leaving the interest on the bonded indebtedn ss incurred for the purchase of the road out of consideration altogether.

There is quite a good deal of coal in New Zealand. The Westport coal in that country is regarded as the best in Australasia. A bill is now, or recently was, pending to develop this coal for steamship purposes. Attempt is being made in England to promote the development of the iron sands of the country, which have given very good analysis, but nothing of note has yet been done.

The subject of South Africa, which Mr. Barnes visited in an interval between two Australasian sojoúrns, may be dismissed briefly. There is very little indication of trade in that country at present. When Lord Roberts came home high expectations were engendered, and numerous commercial men rushed down there in order to be at hand in time. Many of them have had to go home to wait a while, however.

CHICAGO MACHINERY MARKET.

Builders of small and medium-sized engines, who are looking for trouble, think they can discern the appearance of a wee, small cloud in the distant horizon. The makers of large units, on the other hand, see in prospect only an indefinite continuance of their past blessings. These relative conditions may have been foreseen for some time past, for the disposition of a number of makers has been to increase not only the capacities of their various plants, but also the size of the engines constructed. Those who have or are doing so have no occasion for regrets up to the present moment.

The speck on the bright face of business alluded to above is the increasing competition among builders. A consequent shading of prices for small units has recently appeared in this market. The aggregate business of this kind is probably as large as at any time in the past, possibly larger. But not only have a number of new builders appeared in the market, but almost without exception former builders have added greatly to their capacity. The result is that they are not quite so generally working overtime. Some makers, who have been running night and day, are now operating only the large tools of their shops at night, the lighter machines being the less remunerative. And with an accentuation of the present tendencies they see the time coming when only a day force will be required. The more progressive are preparing for that period by installing the most modern and powerful tools, by which they can reduce the cost of production most markedly.

The above rather lugubrious view of the situation is not shared by the makers of large engines, nor by the makers of boilers of large capacity. The Allis-Chalmers Company is at present disposed to accept business with greater caution than for a long time, because of the way it is piling up on them. Babcock & Wilcox Company reports January business fully up to the average month of the year. The January trade of E. C. Darley was the best month ever experienced and February is starting in almost equally well. The outlook for large installations of power is that it will equal, if not surpass, the productive capacities of builders for many months to come. In actual contracts placed the aggregate business during the past month was probably less than that of December, but the number of pending transactions is large. The work is widely scattered and applies to all classes of industrial enterprise.

The Atlas Engine Works, Indianapolis, have commenced improvements which, when finished, will almost double the capacity of the plant.

Quotations.

NEW YORK, Monday, February 10.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$17 65 @ $18 15
No. 2 X	17 15 @ 17 65
No. 2 plain	16 65 @ 17 15
Gray forge	16 15 @ 16 65

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 16 50
No. 2 foundry, or soft	15 75 @ 16 00
No. 3 foundry	15 25 @ 15 50
Foundry forge, or No. 4	14 75 @ 15 00

Bar Iron—Base sizes—Refined brands. mill price on dock, 1.73c. in carload lots. Smaller quantities from store, 1.95 @ 2.00c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—1.95 @ 2.00c. from store. One prominent selling firm consulted names 2.00c. as rock bottom.

Cold Rolled Steel Shafting—Base sizes—From store, 2½c.

Copper—Lake ingot, 12¾ @ 13c.; electrolytic, 12½ @ 12⅞c.; casting, 12½ @ 12¾c. It might be difficult to find the metal at the lower figures.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 24½ @ 24⅝c.

Pig Lead—4.10 @ 4.15c. in carloads.

Manufacturers.

The Lafayette Worsted Company will double its mill at Woonsocket, R. I.

The Riverside Bridge Company, Martins Ferry, Ohio, will erect a new plant at that place shortly.

The Verona Tool Works (chief office, Pittsburgh, Pa.) will in the near future double their capacity.

The Boston Duck Company, of Bondsville, Mass., is to build an addition to its mill early in the spring.

It is understood that a foundry will be built by the Stroudsburg (Pa.) Engine Works Company.

The Three Rivers (Mich.) Paper Company is contemplating the erection of a new paper mill next spring.

The E. R. Thomas Motor Company, Buffalo, N. Y., will add one story to its building at 1192 Niagara street.

The Brunhoff Manufacturing Company, Hamilton, O., metal novelties, has let a contract for a new factory.

The Ithaca (N. Y.) Wall Paper Mills propose to establish a Canadian branch plant, it is reported, at Niagara Falls, Ont.

The Mitchell & Lewis Company, Ltd., manufacturer of wagons, Racine, Wis., proposes to erect an addition, to cost $100,000.

Swift & Co., Chicago, Ill., have practically closed options, it is said, on a site for a large packing plant in New Orleans, La.

Contracts for the erection of the new plant of the Youngstown Steel Casting Company, Youngstown, O., are about being awarded.

The Clare Portland Cement Company, capitalized under the laws of New Jersey at $1,000,000, expects to build a factory at Clare, Mich.

The Standard Knitting Mills Company, of Fifth avenue and Sterling place, South Brooklyn, N. Y., has secured a site for a new factory.

It is understood that the plant of the Wm. B. Scaife Sons Company, at Oakmont, Pittsburgh, Pa., is to be enlarged in the very near future.

H. K. Porter & Co., Pittsburgh, Pa., have purchased additional ground adjoining their present works and will erect an addition to the plant.

The sawmill of William Burton's Sons, Waterford, N. Y., manufacturers of fancy woods and veneers, has been burned, but will be rebuilt.

William E. Uptegrove & Bro., East Tenth street, New York city, propose to move to Greenpoint and erect a sawmill there nearly 500x100 feet.

The Allegheny Valley Railroad is building additions to its Verona (Allegheny County, Pa.) plant that will give employment to 150 additional men.

The American Hoist & Derrick Company, St. Paul, Minn., has applied for a permit for the erection of an addition to its plant, at a cost of $10,000.

A galvanizing plant is to be added to the plant of Neal Bros., Pittsburgh, Pa., in the near future. The plant will have a capacity of about 15 tons daily.

The Detroit (Mich.) Steel & Spring Company has had plans made for an addition to its foundry. This addition will be 75 feet square, one story high.

The Pennsylvania Company is to install a large ore-unloading machine at Ashtabula, O. It will be made by Webster, Camp & Lane Machine Company, Akron, O.

The Republic Iron & Steel Company's plant at Youngstown, O., will be enlarged by the

addition of several continuous mills, remodeling of the blooming mill, etc.

It is stated that plans have been made for a new mill to be built in addition to the plant at Warren, R. I., of the Parker Mills, fine cotton goods, Fall River, Mass.

A new structural and bridge shop is being added to the plant of the National Iron & Wire Company, Cleveland, O. The building will be of steel frame and will measure 50x70 feet.

The plant of the Hewitt Manufacturing Company, 21 Ontario street, Chicago, manufacturer of journal bearings, is to be enlarged by a foundry and office building, 250x150 feet.

W. D. Cargill and John Messner, of Cargill, Ont., have been in Bay City, Mich., looking over the beet sugar factories. They are interested in a proposition to erect a factory near Cargill.

The Old Hickory Company, Parkersburg, W. Va., manufacturer of handles, etc., will increase the capital stock from $20,000 to $40,000. The plant will be enlarged and new machinery added.

Greensboro (Ga.) men are negotiating with the Southern Cotton Oil Company, at Atlanta, Ga., for the erection of a mill at the former place, and it appears likely that the plan will be carried out.

The plans for the new engine-building plant which the Bradley Manufacturing Company, Pittsburgh, Pa., contemplates building are being prepared by S. Diescher & Sons, Hamilton Building, Pittsburgh, Pa.

If the experimental plant of the Canton Crucible Steel Company, Canton, O., proves to be a success, it is the intention of the company to add largely to its capacity. The plant at present is doing very well.

Plans have been prepared for a new wire mill for the Seymour Manufacturing Company, manufacturer of brass, German silver and copper wire, Seymour, Conn. The dimensions will be 60x100 feet, with an ell.

The American Steel Casting Company, Sharon, Pa., has awarded a contract to Wm. McIntyre & Sons, Sharon, for building five new open-hearth steel furnaces, twelve gas producers and five annealing furnaces.

Land has been purchased in Norwalk, O., by the Wheeling & Lake Erie Railway, adjoining their present shops. New shops, 90x250 feet, will be built, and will be equipped with $70,000 worth of new machinery.

J. B. Bartholomew, Peoria, Ill., proposes to build an automobile factory and also a factory for the manufacture of peanut roasters, etc. The Bartholomew Company already manufactures peanut and coffee roasters.

Julian Kennedy, Pittsburgh, Pa., is preparing plans for a new blast furnace to be erected by Pickands, Mather & Co., Cleveland, O. The new stack is to be built at Toledo, O., and will have a capacity of about 400 tons daily.

A. S. Standish, 3036 Penn Avenue, Pittsburgh, Pa., is placing on the market a new style of belt power chain hammers together with a new geared link press. It is his intention to make a full line of chain machinery.

An addition has been under contemplation by the officials of the Huber Manufacturing Company, Marion, O., manufacturer of engines, threshers, rakes and scrapers. The wheel department may be extended about 75 feet.

Joseph G. King, lessee of the Canadian Pacific cleaning elevator at Port Arthur, was recently reported in Minneapolis, Minn., arranging for the purchase of material for the construction of a 1,000,000-bushel elevator at Fort William.

The Wichita Paint & Color Company will succeed the Oilex Paint Company, of Wichita, Kan. The company is planning to increase the capacity of the paint factory from 500 gallons a day to 1,000, and will invest $5,000 in paint machinery.

The Townsend & Downey Shipbuilding & Repair Company, New York, builder of the German Emperor's yacht, is said to have signed contracts for the enlargement of Shooter's Island, where its plant is located, from 15 to 42 acres.

It is proposed to locate in Fall River, Mass., a new fine cotton goods mill, probably having nearly 45,000 spindles. J. Bion Richards, bookkeeper at the Arkwright Mills of that place, is stated to be a prime mover and likely to be treasurer.

The Hunt Air-Brake Company, Pittsburgh, Pa., and the Kensington Foundry Company, of New Kensington, Pa., have consolidated their interests and will make additions and improvements to the New Kensington works at an early date.

The Columbia Bridge Company, of Pittsburgh, Pa., has purchased some 25 acres of land adjoining its plant at Carnegie. A bar mill, blooming mill and shafting plant, altogether employing 700 hands, it is rumored, may be erected on the site.

The National Steam Economizer Company, of Springfield, Mass., which for a year has been making, through a number of manufacturing concerns, the Keller heater, will build a factory in Springfield shortly, which will employ at least 100 hands.

Burd P. Evans, builder, Philadelphia, Pa., has plans from Frederick Fox, architect, for a machine shop and boiler-house for Alfred Insinger, to be erected in Stenton avenue, above Wayne Junction. The machine shop will be two stories, 125x50 feet.

The building contract has been let for the workshop and office building of the Frankford Chain Works, at Margaret and Pearce streets, Frankford, Philadelphia, Pa. It will be a two-story brick structure, with accommodations for twenty forges.

The Petroleum Iron Works Company, Washington, Pa., proposes to build an addition to its plant. It is proposed to place three more punches in the new building, also a pneumatic air hoist. A gas engine or additional boilers are also contemplated.

S. V. Huber & Co., Pittsburgh, Pa., have prepared plans for the large tube works to be built at Sault Ste. Marie by the Algoma Tube Company and awarded the contract for the mill machinery to the United Engineering & Foundry Company, Pittsburgh.

Architects C. A. Fairchild & Bro., of Kalamazoo, Mich., have made plans for a foundry plant for the Charles Clarage Company, including a foundry, 75x150 feet; cupola room, 20x30 feet, and core room, 26x50 feet, also a pattern storage room, 50x60 feet.

The Northside Iron Company, of Sharpsville, Pa., has elected the following officers: S. A. Robinson, president; Andrew Nickle, vice-presiden; C. B. Kantner, secretary and treasurer. The company will secure a State charter and will erect a blast furnace.

The Waycross Cotton Mill Company, Waycross, Ga., is being organized. It is to be capitalized at $50,000. George W. Deen has temporarily been elected president, Hon. L. Johnson, vice-president; John A. Lott, secretary and treasurer; Hon. Leon A. Wilson, attorney.

The wire-drawing plant of the Belfont Iron Works Company, Ironton, O., recently made a run of 155 tons of wire, using thirty-six blocks on a twenty-two-hour run. The machinery for this plant was made by the Turner, Vaughn & Taylor Company, Cuyahoga Falls, O.

The Muncie Pulp Company, 132 Mulberry street, New York city, is contemplating the location of a plant at Memphis, Tenn., for the manufacture of pulp products, including paper, from the cottonwood tree, and it is believed that 25,000 tons of the raw material will annually be required.

Theo. M. Hiester, 430 Richard street, Dayton, O., intends to build a refrigerating or ice making machine, using Anhydrous Sulphurous Oxide, which, it is believed, will produce ice or refrigeration on a comparatively small scale as cheaply as is done in large plants with steam or electric power.

The Pennsylvania Engineering Works, New Castle, Pa., are about to erect an extension to the plant, which will double its size. Last fall the capital stock of the concern was increased from $150,000 to $225,000 for this purpose, and now the stockholders are contemplating increasing it to $500,000.

New Castle (Pa.) capital is largely interested in a new manufacturing concern which is to be erected at Wampum. The company, the American Cement Tile Manufacturing Company, has been organized in New Castle, and an application is being made for a charter. The capital is placed at $100,000.

The Deering Harvester Company, of Chicago, Ill., is negotiating with the Town Council of Brockville, Ont., for the erection of a branch of its business in Canada. It proposes erecting three large buildings, with power-house, and the site is specified as 2- acres. It would employ 1,000 on the start.

Max Miller, of Norwalk, Conn., has purchased land at York, Pa., upon which there will be erected a furniture manufactory, 75x120 feet. It will be fully equipped with the best wood-working machinery. There will be two 250 horse-power boilers and two 150 horse-power Corliss engines to furnish power.

A corporation has been organized at Williamsport, Pa., for the purpose of engaging in lumber operations in Louisiana. It is known as the Avoyelles Company and is capitalized at $2,000,000. Timber lands embracing 100,000 acres have been purchased in the parish of Avoyelles, La., and sawmills are proposed to be built.

Charles H. Case, of Highland Park, Conn., and C. F. Lincoln, of Merrow, have formed a parnership for paper manufacturing, principally binders' board. The new concern will be established at Oneco, where it will erect a building, 34x190 feet. They have secured water privileges capable of developing 200 horse-power.

A. W. Gump, who established the Shelby Cycle Manufacturing Company in 1895, having sold that factory, has purchased the business of the Cataract Tool & Optical Company, of Buffalo. This business Mr. Gump will remove to his old city of Dayton, O., where he will manufacture lathes, tools and light machinery.

The William Bros Boiler & Manufacturing Company, with a capital of $300,000, has been incorporated with the following officers: President, William Bros; vice-president, Frederick Bros; secretary, Joseph M. Bros; treasurer, Bernard Bros. The manufacturing plant is now in process of construction in Minneapolis, Minn.

The Massillon Iron & Steel Company, Massillon, O., is installing a new power plant of about 700 horse-power capacity. The engines are being furnished by the Russell Engine Company, Massillon; generators by the Northern Electrical Manufacturing Company.

Madison, Wis., and the boilers by the Erie City Iron Works, Erie, Pa.

Toledo, O., is to have a new iron foundry. Papers for the incorporation of the new company are signed by M. J. Riggs, local manager of the American Bridge Company; George M. Kinsey, W. E. Brown, Thomas Davies and Charles T. Wilkes, all of Toledo. The capital is $25,000. If plans have been carried out, the erection of the building is already under way.

A company has been organized in Denver, Colo., to build a meat packing plant to cost probably $300,000. A canning plant is included. Prominent in the enterprise are President C. F. Morse, of the Denver Union Stock Yards Company, and George Ballantine, manager of the Denver yards. J. J. Cahill, the local representative of the Armour Packing Company, is likely to be selected as manager.

Work has been started on enlargements of the plant of the A. W. Burritt Company, Bridgeport, Conn. There will be a power-house, in which will be installed a new engine and boilers, having an additional capacity of 20 horse-power. The other structure will be a mill, 47x110 feet, two stories, which will be fitted with wood-working machinery of every description, with provision for milling heavy yellow pine timber.

The plant at Buffalo, N. Y., of the Snow Steam Pump Works, part of the International Steam Pump Company, New York city, is to be enlarged. Eight and one-half acres of land, adjacent to that now occupied by the company's plant, have been purchased, and a foundry 132x450, a machine shop 100x450 and an office building 75x100 feet will be erected at once. The contract for the steel work of the foundry building has been let to the American Bridge Company.

The Johnson Wheel Company has been organized at New Orleans, La., with $1,000,000 capital, and a plant will be established there as soon as certain conditions have been complied with. The company has bought from J. N. Johnson the patents on a spring wheel for bicycles and automobiles, etc. The officers of the company are: Albert Mackie, president; J. N. Johnson, vice-president; E. H. McFall, secretary. Mr. Johnson is from Hattiesburg, Miss.

The Johnston Harvester Company, Batavia, N. Y., is planning to build a two-story foundry addition, 310 feet long, and an addition to the warehouse. The foundry addition will allow an increase of the blacksmithing department. A new power plant will be built, and a 500 horse-power engine with direct-connected generator for power and light will be installed. The capital stock is being increased from $500,000 to $1,000,000. The current will supply fifty motors of from 5 to 50 horse-power.

A new company has been formed, to be known as the Textile Machinery Company, for building and introducing the "Dunn flyer" and other cotton and woolen mill specialties, with a capital stock of $25,000. The main office will be at 66 State street, Boston, Mass., and the work for the present is to be done under contract, for which arrangements have been made with a long-established firm in that line. Fay H. Martin, of Hyde Park, formerly superintendent of the Lowell Machine Shop, is president, and Philip R. Hovey, of Lowell, is treasurer.

Harrisburg is to have a chain works, which expects to be ready to place its products upon the market by next April. It is known as the Pennsylvania Chain Company, and the capital will be $50,000. The officers are: President, Adjutant General Thomas J. Stewart; vice-president, Dr. Alvin I. Miller; secretary and treasurer, D. W. Deming; manager, Charles D. Stucker. The company will erect a plant and operate from sixty to eighty chain fires, and will employ 100 men. They will manufacture all kinds of list chain, and all grades of coil and test chain.

Word comes from Pittsburgh that the National Bridge Company has arranged preliminaries for the purchase of 40 acres at Colonia, on the Ohio River, at a site for a $1,000,000 industrial plant. The main building will be 200x550 feet. There will also be a foundry, forge, machine shop, power-house and a three-story brick office building, 40x110 feet. The capacity of the bridge plant will be 6,000 tons of finished material per month, and there will also be a steel car plant with a capacity of twenty finished cars daily. The works in their entirety will give employment to from 1,200 to 1,500 men. E. M. Schofield is president and general manager of the company, and W. U. Conger, of New York, is treasurer.

The Wright Taper Roller Bearing Company, of Buffalo, N. Y., has been incorporated, with a capital stock of $900,000. Its object is to construct works in Buffalo for the manufacture of an anti-friction taper roller bearing for automobiles, bicycles, road vehicles, line shafting and electric and steam railways, under the American patents of W. Hamilton Wright, who also holds patents throughout Europe. The directors named in the papers are: Lewis J. Bennett, president Buffalo Cement Company; William B. Rankine, second vice-president and treasurer Niagara Falls Power Company; Eugene A. Georger, president of the German Bank; W. Hamilton Wright, Hon. John Laughlin, James P. Wood, Albert C. Thorne, Col. J. H. Horton and Chester G. Smith, all of Buffalo, and Col. C. B. Gaskill and William A. Philpott, Jr., of Niagara Falls, N. Y. A London syndicate controls the use of the patents abroad.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Stamping dies. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will pay 25 cents per copy for issues January 26 and February 16, 1899. Box 158, A. M.

Wanted—Old style screw planer, not less than 42 inches wide. The Highland Machine Co., Boston, Mass.

Shafting straighteners; also volumes and odd numbers "American Machinist," 20 years. J. H. Wells, Tampa, Fla.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

For Sale—A 13x45 in. Barnes No. 6 lathe, with tools, etc.; also 1½ H. P. gasoline engine. Stuart Keneipp, P. O. Box 156, Mt. Carmel, Ill.

Purchaser for small manufacturing plant; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

A thorough machinist, with good shop located in southwestern Ohio, would like to correspond with the object of making permanent contract to build medium-weight machinery; those having established trade preferred. Address Box 117, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Experienced mechanical draftsman desires position. Box 149, AMERICAN MACHINIST.

General machine shop foreman; thoroughly practical man; first-class references. Box 136, AMERICAN MACHINIST.

Competent draftsman on air and gas compressors, steam and gas engines is open for engagement. Box 160, AMERICAN MACHINIST.

Patternmaker of 27 years' experience wishes to correspond with reliable concern wanting foreman; A1 references; age 45. Box 153, AMERICAN MACHINIST.

Thoroughly competent, practical machinist, 11 years as foreman, desires change; transmission machinery and jobbing. Box 155, AMERICAN MACHINIST.

Foreman patternmaker; 32 years; capable in machine, tool, architectural and jobbing work; best references; investigate. J. D. H., care AMERICAN MACHINIST.

Mechanical draftsman, with 9 years' experience, 3 years' on gas engines, desires situation; Philadelphia or vicinity preferred. Address Box 152, AMERICAN MACHINIST.

A practical, experienced superintendent or general foreman desires to change his position; expert in jig and tool system; engine work preferred. Box 157, AMER. MACHINIST.

An engineer (civil and mechanical) and draftsman wishes responsible position; 9 years' experience; best references; heavy machinery or mill work preferred. Box 150, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, desires responsible position with progressive concern; 4 years' experience, shop, power, plants, conveying and elevating machinery. Address Box 122, AMERICAN MACHINIST.

Mechanical engineer, experienced designer of automatic machinery and tools, thoroughly competent to take charge of design and construction, graduate, with references, wants responsible position. Box 148, AM. MACH.

A designing engineer, well up in Corliss engines, pumping machinery and power transmission, practical, inventive, accurate, wide experience as constructor and erector, familiar with shop practice, is open for engagement. Box 154, AMERICAN MACHINIST.

Manager or superintendent of works; a practical mechanical engineer desires change; experienced in estimating and designing hoisting, conveying machinery; capable of handling machine, foundry and blacksmith shops to reduce cost of manufacture. Box 151, A. M.

Help Wanted.

Wanted—Vise hands on fine machine tools; competent men only. Kempsmith Mfg. Co., Milwaukee, Wis.

Wanted—Two experienced patternmakers for Colorado; wages 30 cents per hour. Address Box 105, AMERICAN MACHINIST.

Wanted—Working foreman toolmaker accustomed to screw machine tools. Address "Automatics," care AMERICAN MACHINIST.

Three machine tool foremen, two erection foremen and two inspectors used to heavy machine work. Box 115, AMER. MACHINIST.

Wanted—Two experienced mechanical draftsmen on electrical machinery; thorough and practical men wanted. D., care AM. M.

Wanted—Young man to make tracings and detail work; write, giving full particulars as to age and experience. Box 144, AM. MACH.

Wanted—Brass foundry foreman, experienced on valve work, brass fittings; state age, experience and salary expected. Box 143, AMERICAN MACHINIST.

Wanted—Number of patternmakers, experienced on compressor or steam engine work; none others need apply. Franklin Air Compressor Co., Franklin, Pa.

Wanted—Five experienced machinists for Colorado, to run tools, boring mill, planer

and lathes; wages 30 cents per hour. Address Box 106, AMERICAN MACHINIST.

Wanted—Machinists accustomed to accurate work; good wages and steady employment to the right men. Leland & Faulconer Manufacturing Company, Detroit, Mich.

Wanted—First-class toolmaker, experienced on valve tools and fittings, capable of taking charge; state age, experience and wages expected. Box 142, AMERICAN MACHINIST.

Wanted—A good detail draftsman with experience in machine tool work; must be quick and accurate; state age, experience and salary. Address Box 145, AMER. MACHINIST.

Wanted—A first-class toolmaker, experienced in making cutters for gears preferred; also one gear cutting man for office and shop. Address Boston Gear Works, Boston, Mass.

Wanted—A first-class machine tool designer, one accustomed to small and medium machine tools and having had experience on high-grade work. Address L., care AM. M.

Wanted—Foundry foreman for modern shop in Central New York employing about ninety iron and ten brass molders; state age, experience, wages and references. Box 159, AM. M.

Wanted—Some electrical and mechanical draftsmen for switchboard and general drafting work. Applying Engineer of Drafting Dept., General Electric Co., Schenectady, N. Y.

Wanted—A capable, experienced mechanical draftsman; steady position for the right man. Address, giving age, experience and salary expected, Box 156, AMER. MACHINIST.

Wanted—Competent general draftsman. Apply by letter to Eastman Kodak Company, Rochester, N. Y., and state age, experience and salary expected, and give names of former employers.

Mechanics, engineers, electricians, firemen, etc. A free scholarship in engineering will be awarded to a few well-recommended applicants. American School of Correspondence, Boston, Mass.

Wanted—Mechanical draftsman with first-class experience on general machinery, preferably in steel works; state age, experience, reference and salary expected. Address P. O. Box 1042, Philadelphia, Pa.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Shop agents everywhere to introduce a line of high-class machinists' tools, indispensable to every mechanic; an easy way for the right person to make money; full particulars on application. Massachusetts Tool Co., Greenfield, Mass.

Wanted—A man to take charge of machine shop and foundry as general foreman; a man that is familiar with mining machinery and Corliss engines and can handle men to advantage; state wages expected. Address F. O. B., care AMERICAN MACHINIST.

Wanted—A working patternmaker foreman, to take charge of small pattern shop connected with concern located in Western Pennsylvania, building machine tools; give age, experience, salary expected and reference. Box 147, AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman for brass foundry, experienced in making brass valves and fittings, familiar with molding machinery and mixing of metals; state age, experience, salary expected and references. Box 104, AMERICAN MACHINIST.

Wanted—Foreman and layer-out in a contract boiler shop employing 25 men; capable of laying out all kinds of boiler and tank work and experienced in handling men; give age, experience and wages wanted. Address "Cincinnati Boiler Maker," care AM. MACH.

Wanted—First-class designing draftsman, with shop experience preferably, on pump and hydraulic work; must give unquestionable references as to ability and be thoroughly reliable as a mechanic and otherwise; permanent position to satisfactory man; state salary required. Box 134, AMER. MACH.

Wanted—One experienced, up-to-date factory bookkeeper in shop building steam engines and boilers, etc.; give full information as to experience in the details of manufacturing and costs of same; entire new shops in Western Pennsylvania. Address, stating salary expected, Box 131, AMER. MACHINIST.

Wanted—Engineering draftsman, thoroughly competent to make drawings of electrical and other machinery; none other than an expert engineer, willing to work on a drawing board, will be considered; wages $40 per week; preference will be given to a technical graduate. Address Box 146, AM. MACH.

Special Stockholders' Meeting.

Notice is hereby given that a special meeting of the stockholders of the AMERICAN MACHINIST PRESS will be held at the office of the company at No. 218 William street, in the Borough of Manhattan, city of New York, at twelve o'clock noon on Monday, February 17, 1902, for the purpose of voting upon the proposed sale of the property, rights, privileges and franchises of the AMERICAN MACHINIST PRESS to the Hill Publishing Company.

A. LEIGHTON DONNELL, Secretary.
New York, February 1, 1902.

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See Bearing Metal.

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Obermayer Co., S., Cincinnati, O.
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Gay & Ward, Athol, Mass.
Geometric Drill Co., Westville, Ct.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

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Bliss Co., E. W., Brooklyn, N. Y.
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Barnes Co., W. F. & John, Rockford, Ill.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.

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Baker Bros. Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works, New York.
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Cleveland Pneu. Tool Co., Cleveland, Ohio.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
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Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Turret
Niles Tool Works, New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Aurora Tool Works, Aurora, Ind.
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Niles Tool Works, New York.
New Haven Mfg. Co., New Haven, Conn.
Prentice Bros. Co., Worcester, Mass.
Sibley & Ware, South Bend, Ind.

Drills, Center
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
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Niles Tool Works, New York.

Drills, Ratchet
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Albro-Clem Elevator Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Whiting Fdry. Equipment Co., Harvey, Ill.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

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Franklin Mfg. Co., Syracuse, N. Y.

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Backus Water Motor Co., Newark, N. J.
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Mietz, August, New York.
Monarch Gas Engine Co., Indianapolis, Ind.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Detroit, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gas Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
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Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
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Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

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Troy File Works, Troy, N. Y.

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Lunkenheimer Co., Cincinnati, O.
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Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
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Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

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Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Ct.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N Y Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

Gears Molded
Farrel Fdry. & Mch. Co., Ansonia, Conn.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
New Process Raw Hide Co., Syracuse, N. Y.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

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Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Modern Tool Co., Erie, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Rivett-Dock Co., Boston, Mass.

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Ransom Mfg. Co., Oshkosh, Wis.
Universal Mach. Co., Provi., R. I.

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Grinders, Tool
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Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Universal Mach. Co., Providence, R. I.
Whitney Mfg. Co., Hartford, Ct.

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Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Mass.
Universal Mach. Co., Provi., R. I.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Abrasive Material Co., Phila., Pa.
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Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

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Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Ct.
Reed Co., F. E., Worcester, Mass.

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Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Perkins Mach. Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Ct.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Standard Pneumatic Tool Co., Aurora, Ill.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., 23 John st., N. Y. City.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Standard Pneumatic Tool Co., Aurora, Ill.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Nies-Bement-Pond Co., New York.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Alteneder & Son, Theo., Philadelphia, Pa.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Joints, Universal
Baush Machine Tool Co., Springfield, Mass.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y.
Lea Elec. Mfg. Co., Anderson, Ind.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Ct.
Waltham Watch Tool Co., Springfield, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.

Lathe Feed
Nat'l. Mach. Tool Co., Cincin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Diamond Machine Co., Prov., R. I.
Fairbanks Mach. Tool Co., Springfield, O.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Universal Mach. Co., Providence, R. I.
Watson Mach. Co., Paterson, N. J.

Machinists' Small Tools
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Ct.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Wells Bros. Co., Greenfield, Mass.

Measuring Machines
Pratt & Whitney Co., Hartford, Ct.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Ct.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.

Milling Machines, Universal
Amer. Tool Wks. Co., Cincin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Ct.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mch. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eddy Elec. Mfg. Co., Windsor, Ct.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nut Tappers
See Bolt and Nut Machinery.

Oilers
Bay State Stamping Co., Worcester, Mass.

Oil Cups and Covers
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Anderson & Co., E. W., Washington, D. C.
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Copp & Co., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Patent Title & Guarantee Co., New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe and Fittings
Crane Co., Chicago, Ill.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works, New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Ct.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Keystone Mach. Tool Works, Philadelphia, Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hand
Elmes Eng. Co., Chas. F., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Eng. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Perkins Mach. Co., Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Ct.

Pulleys
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.

Pumps, Hydraulic
Elmes Eng. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., Boston, Mass.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincin., O.
Geometric Drill Co., Westville, Ct.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Wks., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Recorders, Speed
Starrett Co., L. S., Athol, Mass.

Rheostats
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Standard Pneumatic Tool Co., Aurora, Ill.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
Ball Bearing Co., Boston, Mass.
Roller Bearing & Equip. Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Keystone Mach. Tool Works, Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Bowler & Co., Geo. H., Cleveland, Ohio.
Davis Iron Works, F. M., Denver, Colo.
Dawson, John H., Chicago, Ill.
Doan & Co., J. B., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works, New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Co., Pawtucket, R. I.
Pratt & WhitneyCo., Hartford, Ct.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mch. Co., Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Machinery
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., N. Y. City.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Crane Co., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.

Thread Cutting Tools
Hart Mfg. Co., The, Cleveland, O.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincin., O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Pawling & Harnischfeger, Milwaukee, Wis.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works, New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Ct.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Valves
See Steam Fittings.

Vises, Metal Workers'
Hollands Mfg. Co., Erie, Pa.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.

Vises, Wood Workers'
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.

Worm Gearing
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.

Military Inventions.

BY GRAHAME H. POWELL.

Personally I fear that I am not a very strong believer in inspiration as a means of solving great mechanical problems, and therefore when a letter comes to the office from some man who says that one day while watching a hawk sailing overhead it came to him in a flash how man could attain aerial flight, I am somewhat inclined to be skeptical, to put it mildly. Yet this is a favorite topic with what we call the itinerant inventor, the man who immediately writes a long, rambling letter to the President stating that he has solved the problem which has so long been the dream of man; that he is patriotic and wishes to give his own country the first chance to acquire the invention and would like the government officials to name a figure which they consider reasonable for such an important invention. This type of correspondent closes by asking a small advance of two or three thousand dollars to perfect his plans—he being a poor man—and invariably "guarantees" the entire success of the venture. The composition of these letters is oftentimes their most interesting feature. Frequently they are written on wrapping paper and in one instance the plain surface of a piece of wallpaper was called into requisition. One peculiar feature about practically all inventions in this line is that the inventor says to "use any suitable motive power."

That aerial navigation may ultimately be attained is firmly believed but it will be through the long-continued exertion and patient research of such men as Langley, Maxim or Santos-Dumont; not to limit the solution to a particular school. The faith of our government is shown by the fact that the Board of Ordnance and Fortification made allotments aggregating some $50,000 to assist Dr. Langley in his experimental work in this direction, and while his work has been carried on without ostentatiousness and advertising, nevertheless he has made substantial progress. It may be as well to say, however, in this connection, that the board is so well satisfied with its progress in this line that it has declined to make further allotments until the completion of the experiments now under way.

Another direction in which a good deal of experimental work has been done, and for which large sums have been allotted, is in the development of a perfectly safe and otherwise satisfactory method of throwing sensitive high explosives. Just about the time this problem was apparently solved, however, high explosives of less sensitive nature than, say, dynamite, but of practically equal power, began to make their appearance, and as these offered increased safety in handling and firing from powder guns, development in recent years has been sought in their perfection rather than in means for firing the extremely sensitive compounds.

The experiments with and adoption of the pneumatic dynamite guns such as were used to arm the "Vesuvius," now practically discarded, are another example of a direction in which the board mentioned has expended considerable sums.

The terrific strain of set-back at the instant of firing a projectile containing high explosives is an unknown quantity—in most cases, I should say, an ignored factor—in the calculations of the itinerant inventor; and this has led to all sorts of propositions, such as having the ingredients of some sensitive explosive contained in glass bottles, which would break at the moment the shell struck its target, form the explosive, and promptly detonate. In this instance, time was an equally unconsidered factor. Only recently a letter was received from a man who claimed to have discovered the only safe method of throwing dynamite from powder guns. In order to determine what is called the "critical point"—that is, the point beyond which no pressure can be applied without detonation of the explosive—this ingenious individual had rigged up a cider press, placed his dynamite therein and screwed up the press as hard as possible, without, as he wrote, exploding the dynamite. The fact that he was able to write at all was sufficient evidence that the dynamite did not go off. The pressure on the base of a projectile in a service gun is between 30,000 and 35,000 pounds to the square inch. As the man referred to did not give the dimensions of the press, the length of lever or pitch of screw, we were unable to determine what pressure he exerted. We only know that this time he did not exceed the critical point. Let us hope that he may be as fortunate in his future experiments.

For some reason that has not been determined, the trend of invention runs in certain grooves, as it were. For instance, for a period of two or three weeks a great majority of the letters received will be relative to methods of range-finding and, again, means for increasing the range of firearms by means of accelerating charges, say. That is, a compound projectile is fired and about the time it reaches the limit of its flight it in turn fires another bullet, which is supposed to continue in the same course. Such a plan always presents the query, Why will not the projectile which contains the charge, upon reaching its limit and firing its bullet, at once start back in the direction from whence it came and, boomerang-like, strike down the one who first fired it? It has been suggested that this cycle-like tendency of invention is due to publication in the "patent insides" of the country newspapers of statements that the government is in need of such and such an invention. This may or may not be so.

Range-finders or distance indicators have called for large expenditures, and while we may be said to have pretty well perfected the device for coast-defense work, the satisfactory instrument for land use is yet to be presented.

The United States is practically committed to the earth and concrete fortification as a means of coast defense to the exclusion of armor plates and turrets, and the experience of the Spanish war has more than ever convinced us of their impregnability; but in the matter of satisfactory mountings for high-power guns there is unquestionably still room for improvement. Whether or not the disappearing gun carriage remains a permanent feature of our coast defenses, there are many situations in which its employment is undesirable, and this necessitates other forms of gun mounting. This is a field well worthy of careful thought by competent designers.

The Board of Ordnance and Fortification makes an annual report to Congress of its work during the year, and included in this report is a statement of the subjects considered for the period covered by the report. A glance over these documents shows many curious inventions and designs. One inventor suggests a "despatch bomb" as a means of communication between the several parts of an army in the field. Imagine the consternation among the officers if one of these bombs containing important despatches should drop into the midst of a council of war, or possibly upon the head of one of the councillors.

Shells to contain sleep-producing ingredients have been presented numberless times, the inventors' idea being to explode the shell near the enemy, put him to sleep and then calmly walk up and capture him without bloodshed. A bomb-dropping device was a balloon from which hung suspended a quantity of high explosive. This balloon was to be sent up during a favorable breeze and, after coming above the heads of the enemy, automatically drop its burden, which would explode, causing endless destruction. The fact that air currents are uncertain and that at different altitudes the currents blow in opposite directions was apparently not considered. This list might be indefinitely extended but we will content ourselves with a single other example. This was the suggestion of a man, to have an enormous sun-glass by means of which beleagured cities could be set on fire or the enemy blinded by the light. Probably the only way to avoid this last contingency would be for the enemy to move a few paces to one side from the direct ray of light, provided we can imagine such a means of warfare.

The question naturally arises, What inducement is there to anyone to give his attention to military invention. This is somewhat difficult to answer. In the first place, the rewards, as with commercial inventions, largely depend upon the probable demand for the device. The inventor of the woven cartridge belt worn by all soldiers has realized close on a million dollars from the device, while the man who proposed the soft cap for armor-piercing projectiles received $250,000 from the United States alone and retained the

right to sell his invention abroad. The inventors of the service caliber .30 rifle receive a royalty of one dollar for each gun manufactured. Something like 350,000 of these arms have been completed. These examples will show that military invention, properly applied, does pay.

Dies for a Sheet Metal Bracket.

BY JOSEPH V. WOODWORTH.

These four dies were for producing the sheet-metal bracket shown in Fig. 3. The die and punch used for the first operation are shown in Fig. 4 and are of the gang or "follow" type. The stock used for the brackets was cold-rolled sheet steel 3-32 inch thick and 5/8 inch wide, coming in strips to the width required. The work in this first die was the piercing of the center hole *J* and the two holes *I I* at the ends, trimming and cutting off the ends *H H* to the shape shown and the cutting off of the piece to the required length.

Before making the die it was necessary to determine the exact length required. After this was accomplished, a templet of the shape and size was gotten out, with all holes drilled in their proper positions in the die. The three holes *V V V* were laid out first and drilled and reamed. Two outlines of the end of the templet, with 1/8-inch space between them, were then transferred to the die face from the templet, as shown at *R*. The stock between these two outlines was then worked out. After letting in the hole for the stop-pin *S*, and those for the stripper plate screws, the die was hardened, ground and then drawn to a light straw temper.

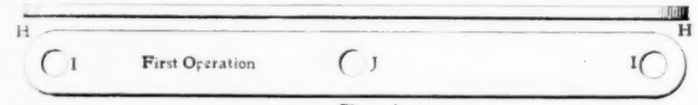


Fig. 1

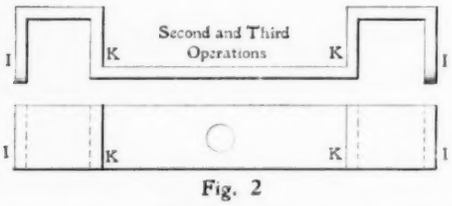


Fig. 2

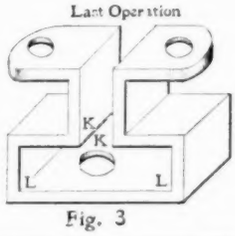


Fig. 3

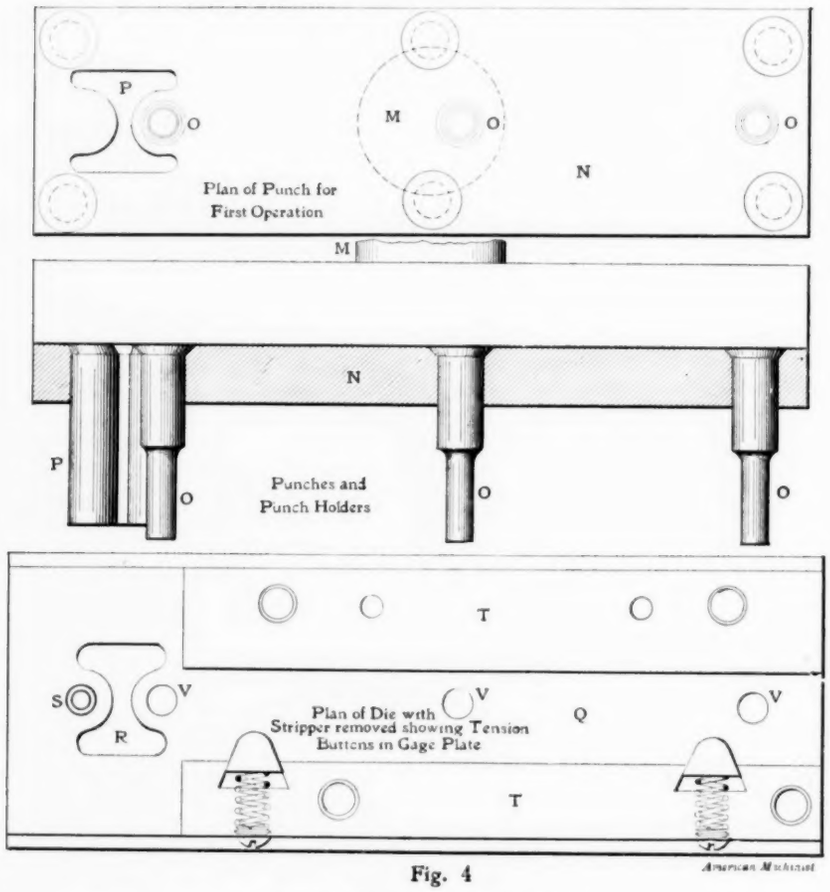


Fig. 4

MAKING A SHEET METAL BRACKET.

In making the punch, Fig. 4, the cast-iron holder or stem was finished first, and then the pad *N*, of 1/2-inch flat machine steel, finished and secured to the face of the holder by six flat-head screws, as shown. The trimming and cutting-off punch *P* was made and finished to a tight fit within the die *R* by shearing it down through the same. It was then hardened and tempered, leaving the face, and up 1/8 inch of the back, a dark blue, and the back allowed to run out soft. It was then let into the pad and upset or riveted at the back, as shown. The blanking punch *P* was then entered into the die *R* and the centers for the piercing punches were transferred through the dies *V V V* to the face of the pad. These holes were then drilled and enlarged for the shanks of the piercing punches *O O O* which were forced into the holes in the pad and upset at the back, as the other. These piercing punches were left 3-16 inch longer than the trimming punch. The two gage plates *T T*, the stop-pin *S* and the stripper plate *V* were got out and located and fastened on the die, with the back gage plate *T* as the locating edge for the work and the front gage plate equipped with tension buttons, to insure the alinement of the stock upon the dies.

When the die was in use a strip of metal was entered beneath the stripper and pushed in against the stop-pin *S*. The punch descending, the three piercing punches *O O O* pierced the strip and entered the die first and before the trimming punch *R* began to cut, thus preventing the stock from shifting. After the end of the stock was trimmed the stock was moved along until the hole pierced at the right-hand end was in line and central with the pin *S*, and the stock was slipped over it with the pin within the hole, thereby locating and centering it correctly for the finishing of the other end and the cutting off of the piece. At the next stroke of the punch the finished piece was cut off and the front end and the holes pierced in the second piece. The finished pieces were removed from pin *S* by the left hand and the metal was fed in with the right.

The punch and die for the first bend, as shown at *K K*, Fig. 2, are shown in Fig. 5. This same die is used for the second bending operation. One punch holder also sufficed for the three bending punches, as did one bolster or die block for the two bending dies. The holder in Fig. 5, of cast iron, was first turned, faced and finished and then set up in the miller vise and a dovetailed channel was let in. The punch was then gotten out and finished as shown at *X*. A clearance hole 1 was drilled into the center of *X* for the locating pin *M* in the die.

For the die, a piece of tool steel, 1 1/2 inches wide and the length required for the second bend, was finished, with a square depression at *C C*, in depth the same as the punch and in width two thicknesses of metal longer. In the exact center of the depression the hole for the

locating pin *M* was drilled to the same diameter as that of the hole *J* in the work. The die was finished to the required length over all, using *M* as a center, and the corners were just relieved of their sharp edge. A blank was then placed on the top of the die with the pin *M* entered into the center hole *J*. It was then clamped square on the face of the die, and holes for two gage pins were laid out. These two holes were then drilled, the pins were driven in, and the front faces filed back until the work, when placed on the locating pin *M*, would rest square against them and in perfect alinement with the die. The punch *X* and the die were then hardened and drawn slightly, leaving the faces very hard. The result of the use of this punch and die is shown at *P*.

For the third operation, that of bending the two ends of the work as shown at *L L*, Fig. 2, all that was required was the punch shown in Fig. 6, the same die being used as for the second operation. This punch also was finished to fit within the holder *W*. It was then cut out at *B B* to

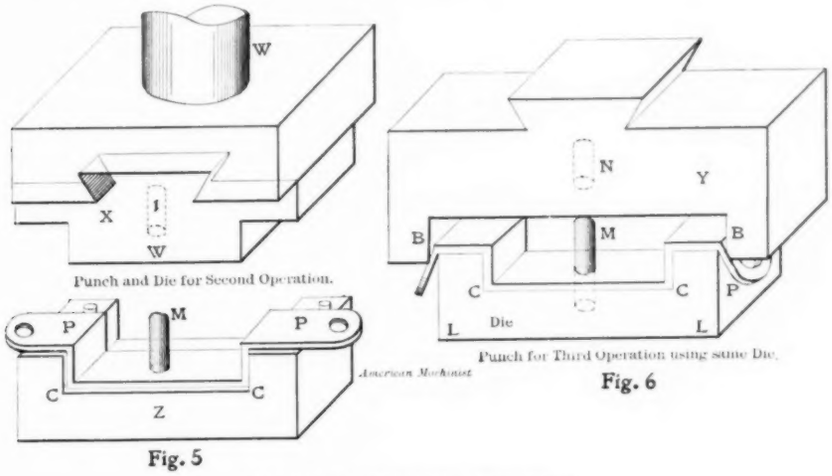


Fig. 5 Fig. 6

MAKING A SHEET METAL BRACKET.

a length two thicknesses of metal longer than the outside length of the die and to the depth shown, with a hole at *N* as clearance for the pin *M*. After the corners *B B* were slightly rounded with a smooth file the punch was hardened and drawn, leaving the face at *B B* very hard and the rest almost soft. The result of this operation is seen at *I I*, Fig. 2.

For bending at *L L* and causing the work to assume the final shape shown in Fig. 3, the punch and die, Fig. 7, were used. The holder is the same used for the other punches. The design and method of constructing this punch and die can be understood from the drawings, and a very slight description will suffice. The work J was located on, and within, the die at the points *I I*. The die was hardened and left very hard at the bending points. The width of the punch at *F F* is two thicknesses of metal less than the die at *H H*. The punch was hardened and drawn, leaving the points *F F* very hard and the rest a very dark blue.

When in use, the punch and die were set up and the work, Fig. 2, was placed in position on the die, as shown at *J*. The punch descending strikes the work in the center and causes the two ends to spring upward and inward, hugging the punch, which, continuing downward, forces and bends the work into the die at *H H*, strikes the bottom with a hard blow, and completes and finishes the work to the shape shown in Fig. 3. The finished work is slid off the punch by hand.

The Premium Plan at the Works of David Rowan & Company—Piece Work, the Premium Plan and Mr. Taylor's Plan Discussed.

BY E. G. HERBERT.

Mr. Rowan in his interesting article, published at page 49, gives such a glowing account of the advantages of the premium system as installed at his works, that I feel tempted to ask for a little enlightenment on one or two points where this system seems to me to be something less than perfect.

One of the chief advantages which Mr. Rowan claims for his method is that the increase of remuneration for successive reductions of time on a job is far more gradual than would be the case with piece work or with the premium systems adopted elsewhere. To put the same thing in other words, Mr. Rowan's system offers far less inducement to his men to increase their output than piece work, and considerably less than any other premium system.

Now it is my conviction, based on experience, that in order to call forth strenuous efforts it is necessary to offer strong inducements, and I am inclined to regard this feature of the system as a distinctly qualified advantage.

Again, it is a matter of common experience that the reduction of the day-work time on a given job by, say, 20 per cent. is a comparatively easy matter if sufficient inducement is offered. To knock off another 20 per cent. from the time so reduced will demand a greatly increased amount of energy, while the reduction of this latter time by a further 20 per cent will be a matter of the utmost difficulty, and will often appear impossible without a radical change of methods. Now, as it is a characteristic feature of Mr. Rowan's system that each successive reduction of time—involving a rapidly increasing demand on the energy and alertness of the workman—is met by a constantly diminishing reward, until finally a stage is reached where the difficulty may be supposed infinitely great and the inducement to overcome it almost infinitely small. Mr. Rowan calls particular attention to the high wages offered by Messrs. Weir to the man who reduces the time on his job to a hundredth of the time allowed him. May it not be reasonably doubted whether

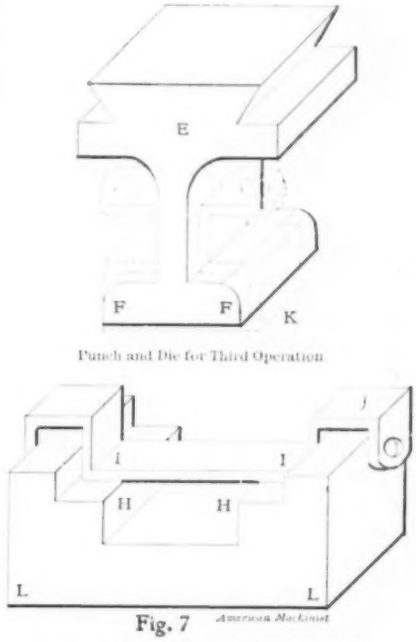


Fig. 7

MAKING A SHEET METAL BRACKET.

the inducements offered by Mr. Rowan's system are likely to result very often in this stage being reached?

Mr. Rowan says that at this point Messrs. Weir will have to cut their rates. No reason is given for this statement, so we must look to the tables for an explanation. From these it appears that the cost of Messrs Weir's job when done in ten hours is $16.50, and when done in one hour $15.15, a reduction of $1.35 in the wages bill alone. Why then cut the rates? Is this $1.35 so little worth saving that it is necessary at this stage to destroy confidence in and wreck the whole system? Apparently we have here a recrudescence of the good old bugbear "earning too much," about which I may say something later.

A thing that has struck me as very strange in connection with every discussion of premium and allied systems is the insistence of the writers on the necessity of a rate fixing department in conjunction with these methods. Mr. Rowan speaks

of the establishment of a rate fixing department in his works along with the premium system, quite as a matter of course. Now, it is far from being my intention to depreciate the value of the rate fixing department, I merely wish to point out, what does not seem to have been generally recognized, that this department is far less essential with the new systems than with the old ones, while in the case of such a system as Mr. Rowan's it is comparatively unimportant. According to Mr. Rowan's own showing, he might by some mistake fix the "time allowed" on a given job 10,000 per cent. above the time in which it could be done, and he would still be paying less than double time. Judging from what one hears, I do not think they often make mistakes of 10,000 per cent. at Messrs. Rowan's, but it is obvious that under a system which allows a latitude of this or even much greater extent without serious consequences, the rate fixing department is far less important than it is with piece work, where an error of this magnitude would lead to paying journeymen at the rate of £180 ($900) a week!

It has always appeared to me that the good results that have generally followed the installation of the premium system have come as the result of correct and permanent rate fixing, and *in spite of* the premium system, and that piece work with correctly fixed and uncut rates has advantages over every other system that has been invented.

The two great obstacles to the success of piece work are the difficulty of fixing rates and the "earning too much" bogey.

On the subject of rate fixing I need not enlarge. In my own case I put out of court the analytical method advocated, I believe, by Mr. Taylor, by which the man is allowed so many minutes for lifting the job on to the machine, so many for scratching his head while he thinks how to cramp it, and so many for each cut, etc. I do not say it is not possible to apply this method, for instance, to the erecting of a complicated machine newly worked out. I know it is possible to stand on one's head on a tight rope, because I have seen a man do it, but ordinary people like myself must be content to leave such things to the Taylors and the Blondins. The difficulty of getting reliable data on a new job, when the men know or suspect that it is being watched with a view to rate fixing, is well known. The two methods which seem to give the best results are: the fixing (with the aid of the time-record card index) of a temporary rate, with an undertaking that it will not be altered for a sufficiently long period, or the offer of a substantial cash bonus for breaking the record. Either method will give good results if the men have confidence that the eventual rate will be fixed on a fair and liberal basis, and will not be cut afterwards.

The "earning too much" bogey has, however, been the most frequent cause of the failure of piece work, and it deserves a little special consideration.

In the first place, I would point out that Mr. Rowan's tables showing the comparative results of his own system and those of Mr. Halsey and Messrs. Weir, give a very partial view of the situation, because they leave out of account the important items of establishment charges and profits.

The ratio between establishment charges and wages differs in different works, but for the purpose of argument the two items may be taken as equal, and this will usually be not far wrong. Taking this into account, it at once appears that the advantage to the employer of a reduction of time is much greater than Mr. Rowan's tables indicate. In the case of piece work the saving of expenses is equal to the piecework balance, and in the case of the premium system it is several times as great as the premium. A concrete example will best show how the interests of the employer and workman are affected.

Suppose the selling price of an article to be $100, made up as follows (on day work):

Materials	40
Established charges	20
Wages	20
Profit	20
	$100

(I am not suggesting that anyone really does make a profit of 20 per cent.; the percentage chosen does not affect the argument.)

Now suppose the job to be put on piece work, with the result that the time is reduced 50 per cent. Two articles will now be made in a given time instead of one, with the following result:

Materials	80
Established charges	20
Wages	40
Profit	60
	$200

Thus it appears that while the man's earnings per hour have doubled, his employer's earnings per hour have trebled. I will not discuss the question whether under these circumstances the employer is "earning too much," but clearly if he is not, nobody else is.

These being the facts, the employer usually at this stage cuts the rates, thereby taking away all incentive to the workman to repeat the process, and being himself punished by ill feeling and lack of interest, as he richly deserves.

The more modern method (called the premium system) consists in taking away the temptation of the employer to put his hand in the workman's pocket, by the simple expedient of arranging so that that receptacle cannot in any case contain anything worth appropriating, and taking away at the same time most of the incentive to the workman to increase his output.

It might appear that the differential rate system was free from most of the objections mentioned. Frankly, I have tried Taylor's system, and I don't like it.

I gave Tommy fifty pieces to turn up and told him if he did them in sixty hours he would get ordinary time; if in fifty hours, time and a quarter; if in forty hours, time and a half. A short calculation convinced him that the forty-hour lot would be bad for his health, therefore not to be considered, but that the fifty-hour lot was a fairly soft thing and worth going for. He started accordingly, and arrived at piece No. 45 with a few—a very few—minutes in hand. Then he got a chip in his eye. He struggled manfully with his chip and his job, but crossed the line a good length behind time. It was not his fault, but what was I to do? Either I must give him his bonus and have the shop assume the appearance of the waiting room of an eye hospital or I must pocket his bonus and go about with a sore place where my conscience ought to be. Another time he would have bad luck with his tools at the beginning of the run, give it up as impossible, and have a good easy time to make up for the hustling he had done for the last month. I soon dropped that system.

In my experience the ideal system is one in which the "time taken" is simply subtracted from the "time allowed," and the difference or "piece work balance" added to the man's time for the week, and paid for at ordinary rates. Above all, correct rate fixing and no cutting, except in case of a change of methods.

Under this system the man knows that every minute saved is a minute's wages, neither more nor less, in his pocket. The employer knows that every penny paid in piece-work earnings represents twopence in increased profits.

Under the premium system the man knows that a few minutes one way or the other make no difference and that the loss of an hour or two only costs him a few pence. The employer *thinks* he is getting the utmost out of his men and machines and pocketing almost all the plunder—but is he?

Manchester, England.

[The argument between the piece-work and the premium plans is essentially an argument regarding the incentive necessary to bring about the desired increase in the output. Experience with the premium plan seems to me to show that with piece work—assuming no cuts to be made—the incentive is too high; that is, under that plan the employer offers more than is necessary to obtain the desired increase. The cuts in the piece rates are really a clumsy and disastrous method of correcting this difficulty. It is easy to magnify the employer's gains under the premium system. These gains depend upon the per

manence of his price list. He is virtually asked to guarantee the permanence of the increased wages, but there is no one to guarantee the permanence of his prices. Prices will continue to fall in the future as in the past. Indeed, nothing is more certain than that the reduced costs due to the premium plan will, under competition, eventually be used as a basis for lower prices. Under such conditions the question of the incentive to be offered must eventually be settled by the application of the principle which is always used in buying anything whatever with money, namely to pay what is necessary to get what is wanted, but to pay no more. When settled on this basis only can the increased earnings endure. Experience with the premium plan on the one hand and the universal cuts under the piece-work plan on the other, show that the initial incentive offered by piece work is higher than this principle would lead to, and hence that it is economically impossible that piece-work rates should be permanent. Nowhere have I urged a rate fixing department as a fundamental necessity in connection with the premium plan. If that plan is to be used in connection with new work, such a department is no doubt necessary. Comparatively little has been said of such an application, however, and in this country I know of but one place where the plan is so used. Practically all the discussion here has related to the application of the system to repetition work, the basis of which is obtained by a simple consultation of old records. As these records become old and as new work is taken up, there will be more need of a rate fixing department in order to forecast the base time or time limit, although with the greater degree of specialization in American as compared with European shops, there is, and will continue to be, less need of such a department here than there, and this is, no doubt, the reason why so much more attention has been given to it there than here.—F. A. H.]

Echoes From the Oil Country.

WATER ANNEALING—HEATING STEEL HOT.

Showing that there are two sides to everything a friend in the West has told us of a "steel medicine" which has given him very good results and which I think will do what he claims for it. I recollect that when I was serving my time I used to save the iron filings from pump and piston rods and turn them over to a blacksmith who ran a shop next door and who did our tool dressing. They, I know, served two purposes. Mixed with borax the blacksmith used it as a welding flux for steel, and claimed he could weld a buggy spring with it without any trouble; that his great trouble was in tempering them properly after welding.

I know he always seemed glad to get all I saved for him. I also know I got many little favors from him in the way of the use of one of his fires, hints on how to do work (which I attempted as I had opportunity), getting a tool tempered or some little job done when I was in a big hurry, etc., in return for them. This was the second and to me most important purpose they served.

Now, we all know—of course we do, or should by this time—that water annealing is only cooling a piece of steel from a certain heat. That there is a certain mystery made of it by those who believe in it may be true, and I, for one, have had a little experience with it that convinces me that I don't know yet all about it. I have practiced it whenever I have been crowded for time since my earliest cub days, when I used to have to dodge the boot of the blacksmith for meddling with his fire when he had a heat on (that was before I knew any better than to touch a fire without asking permission) up to the present time, and I used to think I had it down fine.

Once our shop turned up a lot of work that was forged by a neighboring firm. On one occasion I was told to be ready for a piece of tool steel the first thing in the morning and to rush it through, as the party getting it was in a big hurry and would be in after it. It was forged, heated nicely and put in the lime box in the orthodox way, and in the morning it was so hard that I could not turn it, and I began figuring about how I was ever going to thread it and cut it apart.

After hanging up every tool I had on the lathe board, running the lathe with the slowest speed of the back gear, I became disgusted and took it back to the blacksmith and asked him to give it a "water 'neal," blaming him for careless handling in leaving it so hard. He declared it had been done in the highest style of the art, and that he was working lots of steel, so it must be in the steel itself. Water annealing allowed me to run one speed faster, but that was far too slow, and I did not see how I was to thread it yet; so, after working a few minutes, I took it back and asked to be allowed to anneal it myself. Of course, this was rather a reflection on the ability of the man who had done it before, and he was the working foreman, but he told me to go ahead: "anything to get the work out."

When I got back to the lathe I found I could run one speed faster with care, but that was the best I could do, and that was harder on the tool than I liked. I felt like chucking the piece into some mud hole, when the owner of the blacksmith shop put in an appearance, to see how nearly done the job was and to tell me he expected a man after it any minute.

"But the thing is so confounded hard I can't cut it. It will take me about a week to get it done at this rate," I growled. "The cheapest thing to do is to throw it into the scrap and make a new one out of something that can be worked."

"Didn't Jim put that in the lime over night?" "Yes, and I had it water annealed this morning, and then went and annealed it myself, and this is the best I can do. It is softer than it was at first, but just look at it. I don't know how I will ever get a decent thread on it." And I pointed to the ragged, smoking chips and rough shiny tracks the tool was making.

"I'll fix that for you; take it out and come with me and I'll give it a water anneal that will make it cut like iron." He started for the blacksmith shop while I stuck my hammer handle through the piece and started after him, glad to be able to put the blame for not being able to cut that steel on to a man who wore good clothes and a white shirt week days, for I had no idea that I would be able to touch that piece with a tool after he got through with it.

While the piece was heating he threw a piece of soap into a pail of water and stirred it around until he had a suds, then he let the heat run down in the piece and threw it in and stirred it around, presently fishing it out and handing it to me with "Now you will find you can cut that without any trouble."

The heat he used for the quenching point seemed quite a bit higher than I had been used to, the soapy water was entirely new to me, while stirring the piece while cooling was directly against my earliest training—which had been to hold the piece perfectly still, and many failures had been blamed on my not following that part sufficiently close.

I took the piece up and chucked it again and found that I could turn it at the fastest speed with the gear in without any trouble and I threaded it running on the next slower one. It was altogether the softest water anneal I had ever worked, and it cut smooth and even without any signs of the harsh graininess that had troubled me before, and it was as nice as any annealed steel I had ever tried.

It is rather disagreeable to have one's most positive knowledge proved wrong and a little disconcerting to have some fellow do the thing that is dead wrong and yet get superior results; but if he can and does, the best we can do is to "catch on," for, after all, it is results we are after.

One day a man—a nice, modest, quiet, middle-aged man, who looked me in the eye like a father while he talked—came into the shop (our present one) and wanted to sell me some steel, this steel to be run much faster than any I had and to be heated very hot while working it. After I had agreed to try some, these two points were carefully urged on my memory: that I must speed up at least 50 per cent. and that I must see that the steel was heated hot, and that a good way to be sure it was hot was to melt a little off the point! Think of that, will you, after wanting to pulverize the tool smith for giving you a tool with nice, big, open grain and a tendency to fall to pieces at the slightest provocation. If this man had not seemed so honest, I would have countermanded

my order, but as it was a small one I let it go.

In due time the steel came and for fear I might forget something, a nice letter also came asking me to kindly see that the blacksmith heated the steel *hot* and that the machine I tried it on was speeded up to see what could be done. I cheerfully undertook to see to both points, and I did, and I found that the steel did just what I was told it would do, and, as if that was not enough, I found that it was soft enough to be filed with a fine file.

Some day the scientific men will tell us all about why these things work that way, and in the meantime I will be finding out its weak points and limitations without knowing the whys and wherefores; but, then, I am in the same fix with lots of the other things I am making work, and I know it is one thing to know *what* will happen under given conditions and quite another thing to explain logically *why* it does happen, as I have been convinced more than once by men of superior logic and education that certain things *could* not be and *would* not work, that they were contrary to the laws of natural philosophy, and so forth, until the only prop I had left me was the fact that they were working; so I go on stupidly letting them work and blaming it on a different part of the book on natural philosophy. W. OSBORNE.

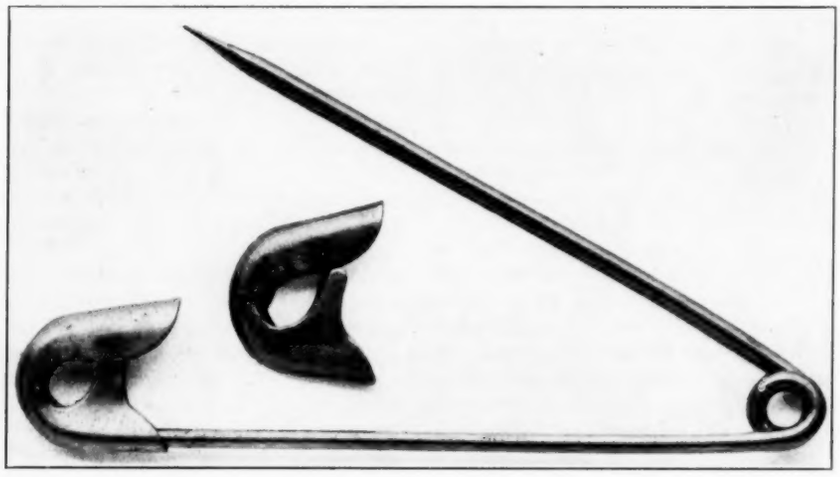


FIG. 1. A SAFETY PIN FOR A HORSE BLANKET.

Making a Large "Safety" Pin.

BY WILLIAM DORAN.

The dies and fixtures described in this article are used in the manufacture of the universally known and used "safety" pins, and the ones produced by the particular set of tools here shown are of the largest size made, as shown in Fig. 1. The pin consists of two parts: the head, or shield, which is blanked and drawn up to the shape shown from sheet brass, and the pin proper from brass wire. The number of operations required to produce pins of this size—which, by the way, are used principally for horse blankets—are seven: the blanking of the piece for the head, the drawing and forming of it, the cutting off and pointing of the wire, the bending of the end which is fastened in the head, the forming of the spring portion, the wiring and fastening of the pin within the head, and last the closing down of the head so as to make the pin "safety." The means used and the manner in which the various operations are accomplished can be clearly understood from the cuts, and very little description is necessary, except as to the methods of constructing some of the tools.

For the first operation—that of punching out the blank for the head—the punch and die shown in Fig. 2 are used. As shown, they are made to produce two blanks at each stroke. With this punch and die an automatic feed was used. In the die *E E* are the blanking dies, *C* the gage plate, *G* the stripper, while *I I* and *H H* are the cap screws and dowels respectively for locating and fastening the stripper and gage plates to the die. In the punch, *C* is the holder, of cast iron, *D* the punch pan, of machine steel, into which the two punches *A A* are let in and upset as shown. The pad is fastened to the holder by four flat-head screws as shown.

The second operation, of drawing and forming the blank, as seen in Fig. 1, is accomplished by the drawing die, Fig. 3. The die consists of the cast-iron body *L*, the drawing or male die *J*, which is screwed down into the body as shown at *Q*; the blank holder *N*, the locating plate *O O*, in which the blank is located, and the regulation spring buffer and the parts for holding the blank while it is being drawn and formed. The male die *J* and the female die *W* are both of tool steel, the male being first turned at *Q* and threaded to screw into and shoulder down in the body *L*, and also threaded smaller at *R* for the spring buffer stud *S*. The drawing portion *J* is then worked down and finished, first by milling and then with files, and after being polished nicely is hardened and drawn slightly. The blank holder is of mild steel, turned to fit easily in the holder or body casting *L*, and worked out in the center to the shape of *J*, so that it will fit around it nicely. The four spring buffer tension pins are shouldered and threaded at one end to screw

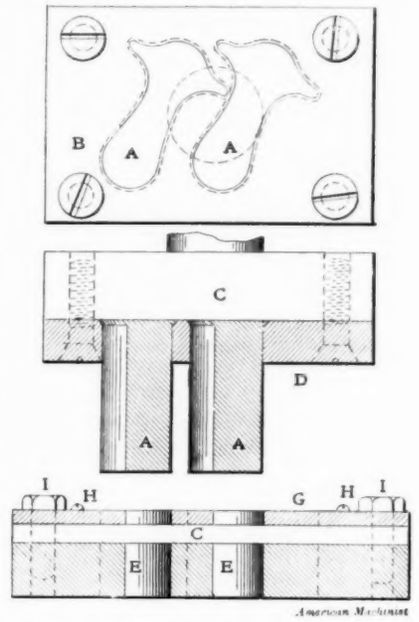


FIG. 2. BLANKING DIE FOR THE SHIELD.

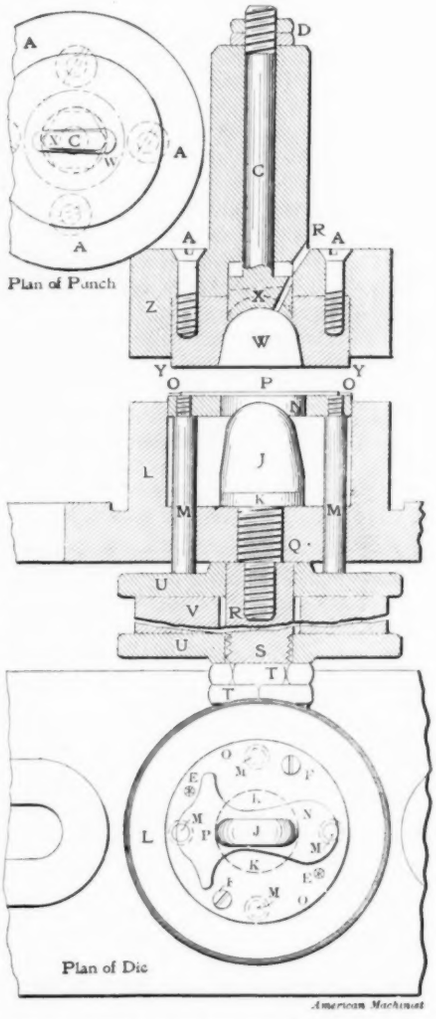


FIG. 3. PUNCH AND DIE FOR FORMING HEAD OR SHIELD OF SAFETY PIN.

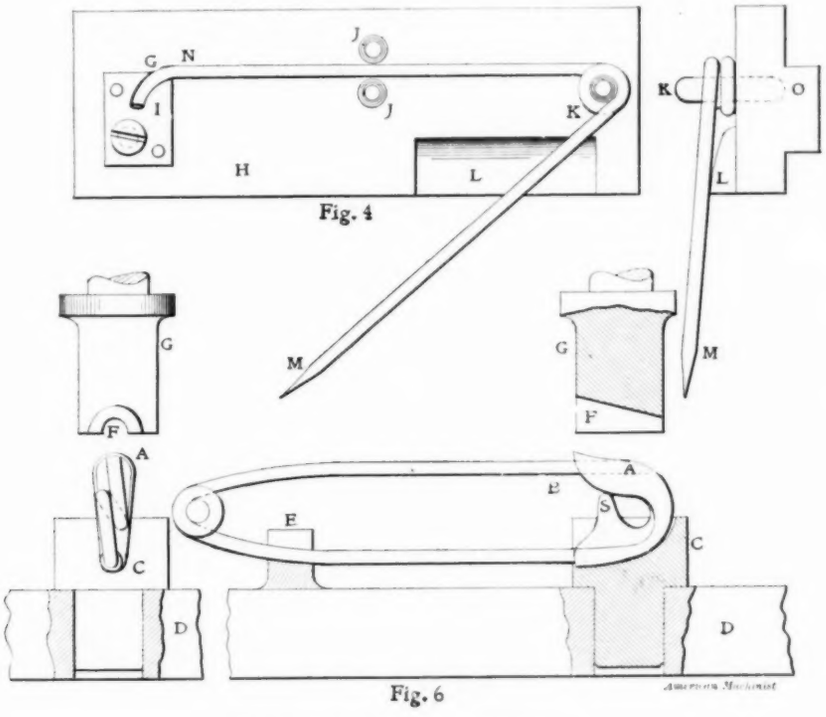
into and shoulder against the back of the blank holder *N*. The blank-locating plate *O O* is made from a piece of sheet brass of a thinner gage than that used for the blanks. The piece of brass is cut larger than the diameter of the blank holder *N*, and is worked out to the shape of the blank, as shown at *P* in the plan view, and, after being located in correct position relative to the drawer and former *J*, is positively located by means of two dowels *E E* and two flat-head screws *F F*, and then turned off on the outside to the size of the blank holder. The spring barrel stud *S* is of machine steel, and instead of being made to screw up into the bolster, it is tapped to screw on to the portion *R* of the male die. *U U* are the two buffer washers, of cast iron, and *V* the rubber buffer, which is 6 inches long. *T T* are the tension adjusting screws.

The punch consists of the cast-iron holder *Z*, which is bored for the knockout *C* and the female drawing die *W*. The knockout *C* is of tool steel with the stem turned to fit the reamed hole in the stem of the holder *Z*, and threaded on the end for the two adjusting nuts *D*. The portion *X* of the knockout is finished to act as the completing portion of the die *W*. There is a small vent hole in both the holder and knockout at *R*; this is to allow of the escape of the small particles of brass which would otherwise accumulate within the die and mark the work. The die *W* and knockout at *X* are hardened and drawn slightly. The die *W* is fastened within the holder *Z* by four flat-head screws *A A A A*, let in through the back. When in use the die is set up in the press as shown in the sectional views, and the press is tilted so that the product will fall off at the back. A blank is located by hand within the plate *O O*, and as the punch descends it is drawn and formed to shape. The action of this die is very rapid, as the blank is easily located and when drawn it is stripped from the die and drops off at the back before the end of the return stroke.

The operations on the pin portion are three. The wire is straight and 10 inches long, and is required to be pointed at one end and bent to conform to the radius of the inside of the head at the other. The first operation, that of cutting off and pointing, is accomplished in the screw machine, the pointing being done with a special box-tool. The second operation, of bending the end to the shape shown at *G*, Fig. 4, is done by means of a simple punch in the foot press. The last operation on the wire is to bend and form the spring portion as shown at *K*. This is accomplished by the fixture shown in the two views of Fig. 4. The bent end *G* of the wire is entered and located to gage within the plate *I*, and the length of wire lies between the pins *J J* and against the forming horn *K*. The wire is formed around this horn or pin as shown in the two views. The inclined surface *L* of the body *H* is necessary, so as to have both ends of the wire in line with each other when fastened within the head. This fixture is used in the vise, gripping it at *O* as shown in the end view.

The next operation is that of enclosing the end *G* of the pin with the head. This is done in the foot press by the means shown in Fig. 5, which is a simple closing-in operation, and as the sketches show clearly the manner in which it is accomplished, very little description is necessary. *V* is the die, of tool steel; *W* the locating or gage plate for the work, and *X* the bolster or die block. The punch consists of two parts—the holder *P*, of cast iron, and the punch *Q*, of tool steel. The manner in which this operation is accomplished can be clearly seen from the sketches.

The last operation is the closing in of the head of the pin so that the points *S* will act as a guide for opening the pin. This operation and the simple tools used are shown in Fig. 6. The tools are used in the foot press.



FORMING THE WIRE OF THE SAFETY PIN.

Hardening Tool Steel Rolls.

BY E. R. MARKHAM.

For many purposes it is necessary to use rolls that are extremely hard and free from soft spots. By the ordinary methods of doing hardening it is extremely difficult to get satisfactory results on this class of work.

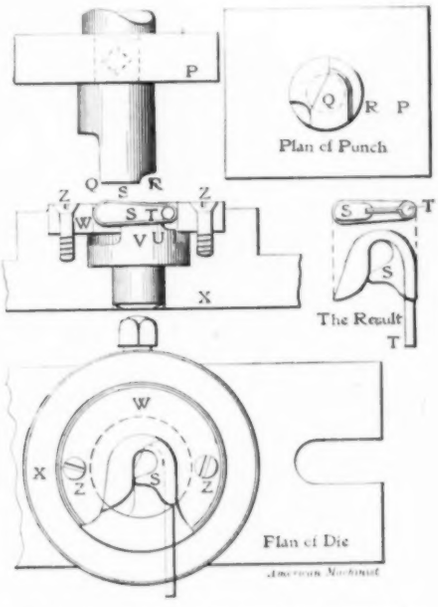


FIG. 5. CLOSING THE HEAD ON THE SAFETY PIN

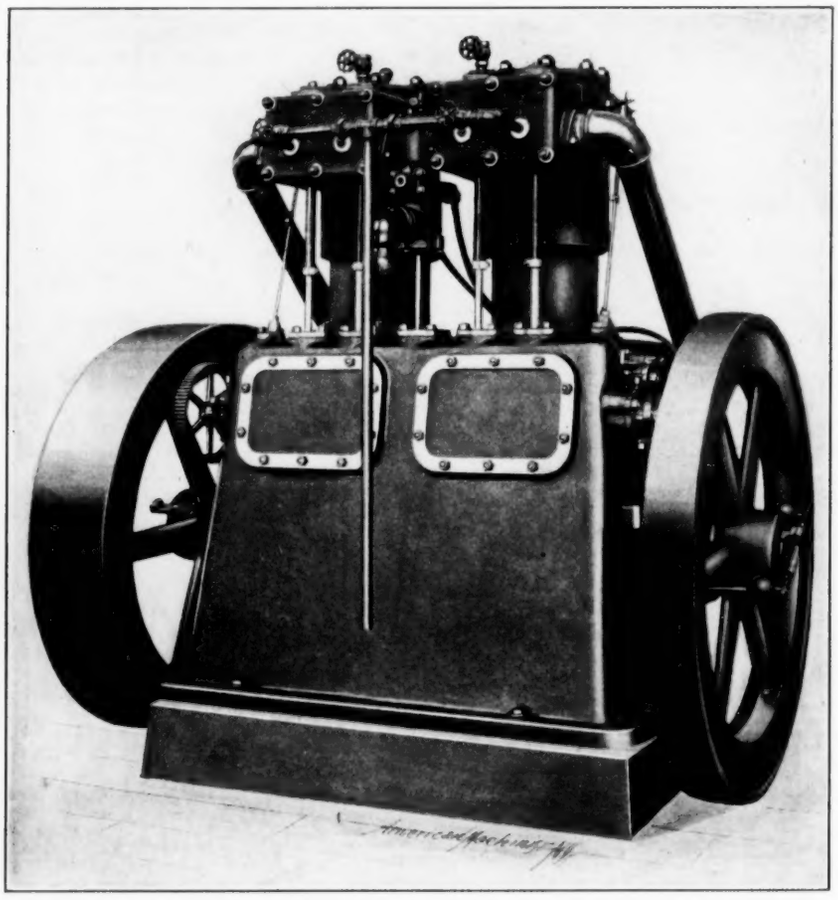
It is not the fault of the steel, as a rule, that it hardens spotty. It may be caused by uneven heating, or by bits of scale adhering to the surface and keeping the liquid in the bath away from the steel, or it may be caused by steam forming by the contact of the red-hot steel and the water and keeping the water from the steel in spots.

It is not necessary to use a *high carbon* steel in order to get good results; in fact I think that a *low carbon* steel, treated by the method I shall describe, will give better satisfaction. The stock used should be at least an eighth of an inch larger in diameter than the finished roll. It should be cut into pieces a trifle longer than the finish length and should be roughed to within a thirty-second of an inch of the size, after having had a hole

somewhat smaller than finish put through it. The rolls should then be packed in a box with powdered charcoal and annealed. In annealing the heat should be a bright red, continued for a length of time sufficient to allow any strains that may be in the steel to be removed. For rolls one to two inches in diameter an hour after the box is heated through would be sufficient. This can be determined by the use of test wires, as described in article on "Case Hardening" on page 126. After having run the proper length of time they should be allowed to cool as slowly as possible. After cooling, they can be machined to size.

To harden they should be packed in hardening boxes with equal quantities of charred leather and charcoal, granulated and well mixed. Do not allow the pieces to come within half an inch of each other or within an inch of the box at any point. Before packing, wire each roll with a piece of iron binding wire. These wires should be long enough to project over the upper edge of the box. Put on the cover and lute with fire-clay. When packed, the boxes should be placed in the furnace. Time the heats by the method referred to, run at a *low* heat for an hour and a half for rolls one inch diameter. Larger rolls should be run proportionately longer. At the expiration of the time take the box from the furnace, take the cover off, and, by means of the wires, remove the rolls one at a time and dip in a bath of strong brine, which should be violently agitated in order to force the steam away from the work, yet not in a manner that would let any air in contact with the roll. The agitating of the bath should be from opposite sides toward the center. The pieces should also be worked up and down in the brine to insure good results. When all traces of red have disappeared and all *singing* has ceased, they can be dropped to the bottom of bath and left to cool.

When the hardening is all done, or from time to time the pieces should be removed from the bath and the strain removed by placing in warm water in a kettle over the fire or connected with a steam pipe and brought to a boil. The temperature of boiling water is about the proper heat to use in removing strains when it is not desirable to draw the temper at all. The lowest temper that shows any trace of color is a light green, 430 degrees. The pieces should be allowed to cool with the water. If the above directions are followed closely, good results should be obtained.



THE MAYWOOD GAS ENGINE.

The Maywood Gas Engine.

One of the modern requirements for a gas engine is that it shall be capable of close speed regulation, and another is that it shall be thoroughly reliable in its action. These two considerations have led to the very general plan of operating the engine on the so-called Otto cycle and to govern by a throttling governor.

The Maywood engine makes use of this combination, and the working out of the design permits full advantage to be taken of these well-known features.

The base or crank case contains three bearings for the crank shaft, to which access is afforded by large doors in the rear. Two smaller doors in the front enable the cam shaft and its mechanism to be inspected. This cam shaft is driven at half the speed of the crank shaft by a train of spur gears, and carries inlet, exhaust and igniter cams for each cylinder. The main and cam shaft bearings are babbitted and the connecting rod bearings are phosphor bronze. The cylinders surmounting the crank case have valve chests bolted to the front, and these chests are connected by a throttle valve casing whose valve is controlled by the governor. The governor valve is arranged to vary the quantity of the mixture admitted to the cylinders, but with no change in the proportion of gas and air, which after being once adjusted remains constant.

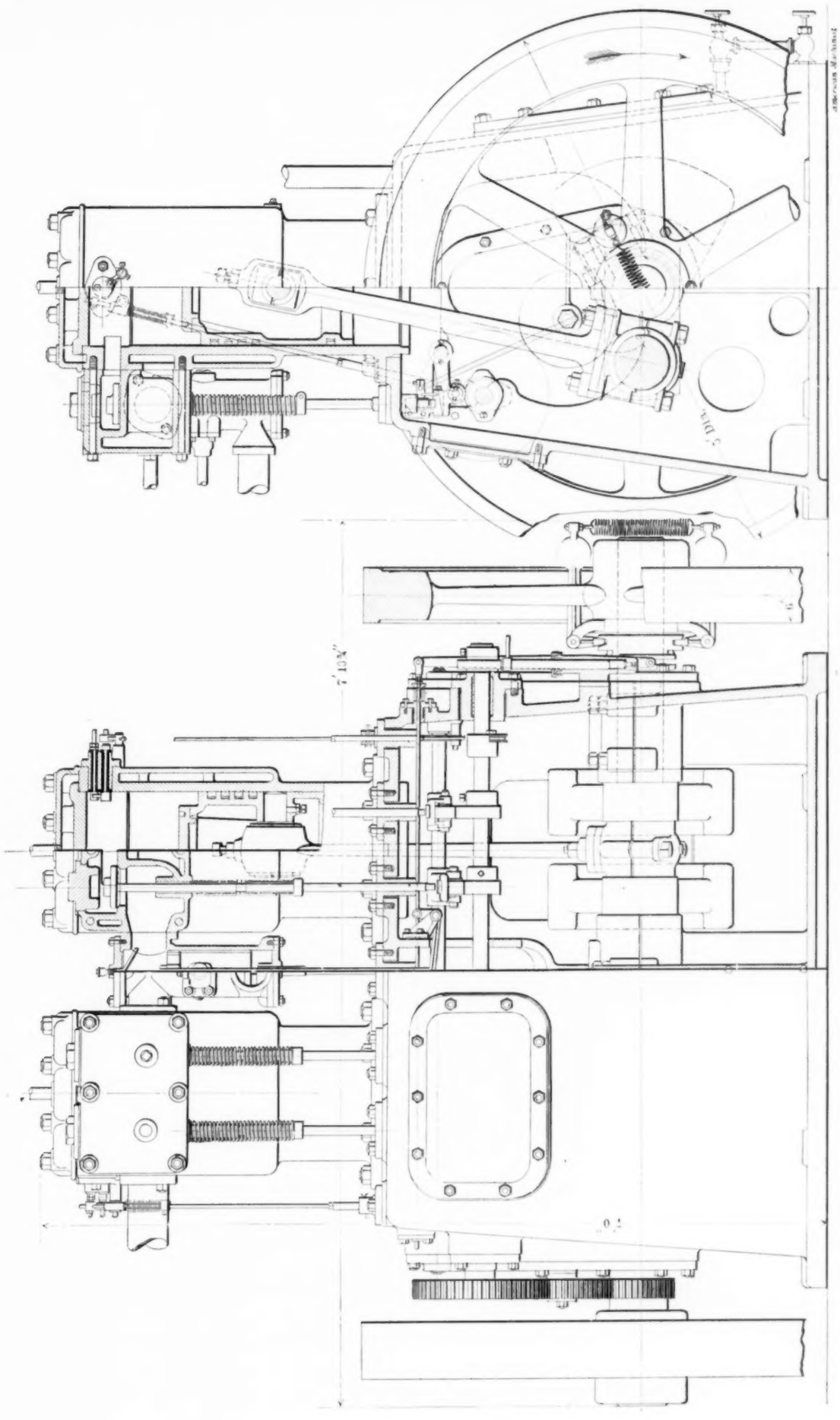
The governor is of the fly-ball type, and is located in the flywheel. As the balls diverge they slide a collar along the shaft which by a system of levers transmits the movement to the throttle between the cylinders. A spring on one of the rods permits a change in the speed of the engine being made while the engine is running.

The valves are of the poppet type and are positively operated by the cams. The seats are so located that when worn they may be readily bored out and bushed for renewal. Operating the inlet valves by cam permits heavier valves and springs to be used than would otherwise be possible with the increased certainty of their seating tight.

The pistons are closed at the top by a removable plate, so that the wrist pin brasses may be adjusted most conveniently. Five rings are provided in piston.

The igniter is of the hammer break form, in which the raising of a rod by the cam allows a light spring to make contact between the electrodes; when the cam suddenly releases the rod, its weight, reinforced by a spring, overcomes the light contact spring and causes a very sharp break in the circuit. Both terminals pass through insulating bushings.

The igniting current is furnished by a dynamo and an Edison-Salaude battery and spark coil. The battery is used for starting, and after the engine is up to speed, a double-throw switch can be turned, cutting out the battery and throwing in the dynamo. The cylinders, including the heads and entire valve chests, are water jacketed. The builders are the Maywood Foundry & Machine Company, Maywood, Ill.



12½X16-INCH, 50-HORSE-POWER MAYWOOD GAS ENGINE.

Springs.

BY A. A. CARY.

The following article is an abstract of Mr. Cary's remarks in discussion of Professor Benjamin's paper before the recent meeting of the American Society of Mechanical Engineers (republished at page 154) and of his contribution to the topical discussion on "A Spring Testing Machine."

After protesting against Professor Benjamin's use of the term spiral spring as a name for what are really helical springs, Mr. Cary said:

"The formulas given in this paper for the calculation of helical springs are practically the same as given by Reuleaux in 'Der Constructeur' and based upon the assumption that the bar or wire composing the spring is subjected wholly to a torsional strain, and the torsional stress in the bar or wire when the spring is deflected is equivalent to the moment obtained by multiplying one-half the mean diameter of the spring by the applied load in pounds.

"When interested in the manufacture of springs, a number of years ago, I made considerable use of these formulas and found them fairly satisfactory when the diameter of the spring was large compared with the diameter of its wire, but in a majority of cases I found that my results obtained by such calculations differed more or less from those obtained in the test scale, which led me to realize that there were many other stresses in the wire of the spring, resisting the applied load, than those of purely torsional stress.

"When we consider the many different methods of making springs, the various ways of preparing the wire for them, their treatment during manufacturee and their treatment after they leave the spring machine, we can more readily appreciate what I have just said.

"Thus we find springs made from 'hard drawn or 'hard rolled' wire which receive no tempering treatment after being coiled. Wire made hard by working (as just described) owes this quality (of hardness) to the many internal stresses it contains, which can be removed by proper heating and subsequent treatment, which softening process is, of course, avoided in the manufacture of such springs, which have a comparatively limited elastic limit and are easily 'fatigued.' Almost any of the harder metals can be used in the formation of such springs, such as steel, iron, brass, copper, bronze, platinum, etc.

"A 'hard drawn' or 'hard rolled' *steel* spring can be much improved by a process invented and patented by my father, by which the spring, after being formed and pressed, is heated to a temperature between 400 and 700 degrees Fahr. and then rapidly cooled in a blast of cold air. A spring of this kind, after this treatment, seems to have the internal stresses which were introduced during the coiling and pressing processes removed; its elastic limit is materially increased and it is less easily 'fatigued.'

"In making *compression* springs by this process it is found necessary to coil them to a considerably greater pitch than is found in the finished spring, and then they must be 'pressed'—that is, subjected to a sudden overload (beyond their original elastic limit) which reduces their pitch considerably (although introducing new internal strains, which I will consider later), and then we obtain a fairly efficient spring, but one inferior to a tempered steel spring.

"Another very general method of making steel springs is to take wire tempered by the continuous Waterman process (which I described in Vol. XV Transactions of the American Society of Mechanical Engineers, page 1139) and coil it into the desired shape. The temper in the wire raises its elastic limit and makes it sufficiently hard to produce a good spring. To obtain the best results the wire must be tempered as "high" as possible to allow its being bent over the arbor or former on which the spring is shaped, and the best spring manufacturers are very particular about this point.

"A compression spring made by this method will take a certain amount of 'set' after it is boiled, but after being solidly compressed two or three times under an overload will not 'fatigue' for a long time. Of course, internal stresses are introduced into the wire during the process of coiling, which act together with the torsional stresses when the spring is under load, but these internal stresses are practically all removed by the Cary process of tempering described above, and a spring thus made will last almost indefinitely without fatiguing.

"In the manufacture of small springs, many use piano wire, which is both tempered and hard drawn, and owing to the many seemingly powerful internal stresses found in such wire, when added to the torsional stresses developed during the action of the spring, the elastic limit of the spring is soon reached by a comparatively short elongation or extension, although the resistance to extension or compression is considerably greater (within the elastic limit) than in springs formed from any other kind of wire of the same size. This is probably due to the overstrained condition of the metal, as will be mentioned later. The stresses due to coiling or pressing such springs can also be removed by treating the spring finally by the Cary process of tempering.

"The best and most durable springs that can be made are formed from comparatively high carbon soft steel wire which, after being finished, are 'hand tempered'—that is, they are first heated in a charcoal fire to a cherry red or slightly higher, and then plunged into a liquid bath, which is generally one of oil. They are then carefully polished (over more or less of their surface) and held above the charcoal fire until the required temper color appears, which color differs with the various qualities of steel used.

"There are many variations of this process, differing in small particulars, but so delicate are the different manipulations if uniform results in any considerable number of these springs are to be obtained, that the process has been almost entirely abandoned by spring manufacturers, the best of whom have adopted specially prepared tempered wire for their spring stock, and after forming and machining their springs they are tempered by the Cary process.

"I might add here that my most uniform results in hand tempering springs were obtained by heating and afterwards drawing them by passing an electric current through them. The wire composing such hand tempered springs is, if they are properly made, free from all internal stresses when the spring is at rest, and in properly proportioned compression springs there is no setting or decrease in pitch after the coils are closed tightly one upon the other.

"Another method of making springs is to take steel wire or bars and heat them to a lower temperature than a welding heat, then coil them hot on the arbor, and before they have an opportunity to cool below a dull red throw them into an oil bath, which suddenly chills and hardens them. The quality of steel used in this process is sufficiently low in carbon to make it unnecessary to draw the temper after hardening, but such springs are not to be classed as high grade by any means. Most of the heavy car springs are made this way.

"In plunging red hot springs into their cooling bath great care must be exercised. If they are slowly immersed sideways, one side of the spring will often be tempered harder than the other, because of the different temperatures of the opposite sides of the spring when they are immersed. A similar result is sometimes obtained when long springs are slowly immersed endwise, one end of the spring being found harder than the other.

"It is difficult for inexperienced spring temperers to produce straight springs by the 'hand tempered' process, and unless the spring is straight axially, the distribution of the torsional stresses throughout the length of the wire will be found more or less uneven. In such cases bending stresses are added to those of torsion.

"I have made considerable mention, thus far, of compression springs, but there are equally interesting considerations in connection with springs that resist extension.

"Experience has taught that the most serviceable extension springs are those coiled in such a manner as to have their coils, before extension, press so closely together as to require the application of a certain initial load before the coils begin to open. This 'initial set,' as it is termed

by spring makers, is obtained by using hard drawn or tempered spring wire and delivering it to the arbor on which the spring is formed in a twisted manner—that is, by twisting or revolving the wire around its own axis the same as the strands of a rope are twiste' firmly together. This end is simply obtained by taking one or more turns of the wire (coming from the coil) around the handle of the tool which guides the wire upon the mandrel. This guiding tool either partially or completely encircles the arbor and has its handle project at right angles to the axis of the arbor, towards the coil of wire from which the spring is formed. It has been found that the Cary process of tempering does not affect this initial torsional strain in extension springs, although the hand tempering process, where the spring is heated to redness, destroys it.

"By twisting the wire around the handle of the forming tool in the opposite direction to that described above, the coils of the extension spring will be slightly separated. This latter method of winding is often used in forming helical springs which are to be used as torsion springs, to resist a twisting around the axis of the spring, in which case it is most desirable that the coils do not touch each other and produce friction. I have found it difficult to predict by calculation just what the initial torsional stress in such extension spring will be, as it does not seem to be a constant quantity, and, of course, the spring will not begin to obey Hookes' law until after the coils begin to separate.

"I have now mentioned some of the stresses found in the wire composing helical springs, which act together with the torsional stresses when the spring is extended or compressed, but have not included those of bending or direct shearing which are also found in these springs, more especially in springs wound to small diameters as compared with the diameter of the wire forming them and in compression springs having a large spacing between their coils.

"When a compression spring is loaded we find the ends of such springs, if they are free to move, turning in a direction which would uncoil them and in the case of loaded extension springs under the same condition heir ends turn in the opposite direction, such as would tend to coil them up still further, or decrease their diameter. This is partly due to the transverse strain upon the wire due to the bending action.

"Again, when a spring sustains a load, there exists a direct shearing strain which tends to shear the wire across its section the same as a load on a beam tends to cause it to shear. Such shearing stresses ar practically negligible in springs wound many times larger in diameter than the diameter of their wire, but where a spring has a small diameter compared with the diameter of its wire this becomes a very appreciable quantity, as do also the bending stresses, and by turning to the results shown in this paper on page 5 under "group 18," where the mean diameter of the spring is only about 3½ times the diameter of the wire, I believe that the calculated results obtained by Professor Benjamin showing a very high modulus of elasticity were due to excessive bending and direct shearing stresses existing with those of torsion.

"Concerning the matter of straining spring wire beyond its elastic limit and the results following such over straining there are some very interesting facts which do not seem to be generally understood. For instance, compression springs, when made by certain methods just described, after leaving the coiling machine, are compressed by the manufacturer under an overload which strains them beyond their elastic limit and reduces their length.

"When a rod of wire is twisted beyond its elastic limit a permanent set takes place and a point on the circumference of the wire does not return to its original position when the load is removed. If now the twisted rod be removed, it will be found that the outer parts of the wire are subject to a negative, and the inside to a positive strain. Next, if the bar be subjected to any twisting load less than the one which produced the permanent set, notwithstanding the fact that this new load may be greater than one which would load the spring originally beyond its limit of elasticity, no further permanent set will take place, providing the wire be twisted in the *same* direction that it was twisted originally. If, however, we attempt to twist this wire in the opposite direction just about one-half of the original load will produce permanent set. In fact, the bar in its new state has twice as much elastic strength to resist torsion in the one direction as in the other. It has two limits of elasticity for opposite kinds of twisting loads, and, if we are to avoid a new permanent set, we must take care that our twisting loads do not exceed those limits.

"In tracing the many stresses found in helical springs under load and also the varying limits of elasticity of the wire, my purpose has been to show a reason for the many expressions of dissatisfaction heard concerning the application of the formulas given in this paper, as well as regarding other formulas found in books treating on the subject.

"During the coarse of my spring work, I attempted to obtain a value for the modulus of torsional elasticity G, by calculations from results obtained by testing springs in the test scale, and found in this way a very large range of variations (running from about 10,000,000 up to slightly over 16,000,000) due to the presence of many other stresses besides those of torsion in the wire of the loaded spring.

"When experience taught me to realize the reason for my unsatisfactory and variable results, I began testing torsionally straight rods of wire cut directly from my spring stock and then obtained a much greater uniformity of results, running from 12,400,000 up to 13,000,000, but averaging in the neighborhood of 12,600,000, which value I finally adopted for all kinds of steel under all degrees of temper.

"I believe that this latter method for obtaining the true value of G is the only correct one.

"I am sorry to find that I preserved so few data from my experimental spring work, and owing to this fact can say comparatively little concerning my determined value of the torsional stress S, but I find in my notes that for the maximum stress in the normal section under the load (or, in other words, the stress at the most remote fiber of the section) for wires running larger than No. 1 gage (which is approximately 5-16 inch in diameter), and for those less than ½ inch in diameter my adopted values were:

For 5 diameter springs $S = 100{,}000$.
For 10 diameter springs $S = 75{,}000$.
For 15 diameter springs $S = 50{,}000$.

"The diameter of the spring used for most calculations is that measured from the center of the wire on one side to the center of the wire on the opposite side, at right angles to the axis of the spring. In the spring business I termed this the *pitch* diameter of the spring, to distinguish it from the inside or outside diameter, and in speaking of a spring having a pitch diameter equal to five times the diameter of the wire composing it, it was commonly termed a five diameter spring.

"It will be seen that the above values for S do not differ greatly from those given by Prof. Benjamin. For smaller wires than No. 1 gage my values for S were greater than those given above, as stated by Prof. Benjamin in this paper.

"I am afraid that I will be obliged to take exception to Prof. Benjamin's definition of a well-proportioned spring where he places a three diameter spring within the range of good proportion. Experience has taught me that a ratio between the diameter of the wire and the diameter of the spring of 1 to 5 is as low a limit for R as it is safe to adopt for good serviceable springs. From seven to nine diameter springs certainly give the best all-around results, and I would advise the adoption of such proportions whenever it is possible to use them.

"There seems to be a very common idea that by tempering steel wire its modulus of elasticity (in tension or in torsion) is changed. This is a mistaken idea, as the moduli remain constant, the most important change obtained by tempering being a very material increase in the elastic limit of the wire.

"In my early experiments to determine the value of the torsional modulus of elasticity for use in spring formulas, I began by taking pieces of *tempered* straight wire from the same material that would afterwards be used in making the springs

Afterward I experimented with the same material, only using soft steel instead of tempered, and found that I obtained the same results, and further I found that almost identical results were obtained from tests of the various qualities of steel used in spring making, and therefore I settled upon practically a definite value for my torsional modulus of elasticity.

"All further torsional testing of steel spring material by me was simply to determine the limit of torsional elasticity, which varied with the quality of steel used and with the method or degree of tempering, and for this work the test bars were straightened and then tempered in identically the same manner that the spring would be tempered.

"Without a knowledge of these facts, which I have proved in a number of tests, many think that the torsional resistance per each degree of twist is considerably greater in the tempered piece of wire than it is in the soft piece within the elastic limits.

"In a *perfectly* tempered spring of good proportions and containing a high grade of spring stock, there should be no fatiguing, and such a spring should stand up and have the same endurance after being subjected to a blow as it did before, providing it has not been strained beyond its elastic limit. Such perfect springs require a most careful process of manufacture, but I have produced them for customers who were willing to pay a good, round price. The average well-made good quality springs, such as are ordinarily obtained from first-class spring makers, will generally, at first, take a certain amount of set, but after receiving one or two sudden compressions under an overload they should remain unchanged for an indefinite period of time.

"Springs which will not take a set under such compressions must be made of a steel running comparatively high in carbon and the tempering process used in manufacturing them involves very delicate manipulation. For a great majority of purposes it is not desirable to use so high a grade of steel, as springs made from it are more apt to break in use and they are less apt to run uniform when a large number are required, and it is therefore better to use a considerably lower grade of steel which will permit a much less careful tempering being used.

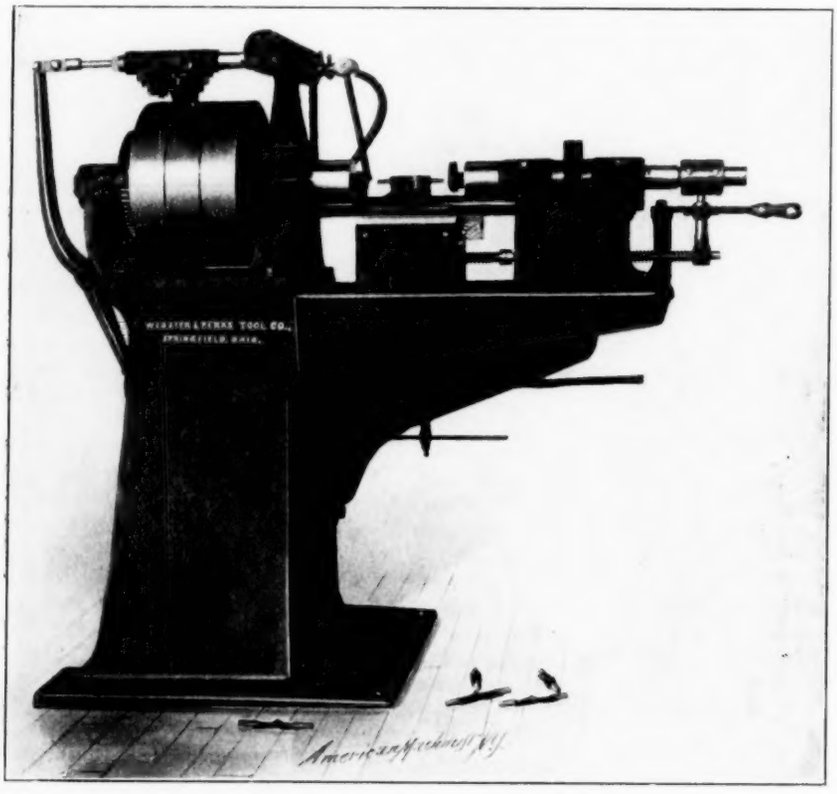


FIG. 1. DUPLEX THREAD CUTTING MACHINE.

"When I was interested in the manufacture of springs a number of years ago, out of a lot of 10,000 helical springs sent out for various uses, we might hear of trouble or breakage occurring to one or possibly two, but complaints received from users of a like number of springs made from flat wire were many times as frequent.

"The friction between the adjoining metal composing flat wire springs, whether they are in the shape of leaf springs or spiral springs, such as are used in clocks, is very considerable, and with such friction the comparatively thin flat bars or flat wire of which the spring is composed, is constantly being worn out and weakened, and this friction constantly interferes with the perfect free movement of the spring in doing work.

"Springs made of flat bars or flat wire are much more difficult to temper evenly than those made from round or square wire, and they are less able to stand sudden shocks, blows or injury of any kind."

Duplex Thread Cutting Machine.

A duplex thread-cutting machine or double-ended bolt cutter has recently been designed for cutting threads on both ends of studs, or such clips as are in general use on carriages and wagons. These clips are forged straight and after the ends are threaded the pieces are bent to their final form.

A machine for handling this class of work must be capable of cutting either right or left-hand threads on the ends simultaneously, and must be partly automatic in its action, stopping and reversing the dies at the proper point and when the dies are free from the work must quickly give sufficient clearance, so that the work may be removed and a new piece inserted.

Fig. 2 shows the details of the machine illustrated in Fig. 1. The main spindle is driven by open and crossed belts and the rear spindle is driven through the medium of a train of gears, of which *Q* is the first, and a shaft *S* running along the back of the machine. A hand lever *R* is pivoted to the frame and moves the rear spindle endwise by the collars, as shown. It also carries an arm to which is attached the rod *H*. The work is held in a fixture on the slide *T* and *H* moves this slide forward at the same time that the rear spindle is advanced until the work strikes the die in the main spindle. Continuing the pressure on *R* will now compress the spring *C* and allow the rear spindle to overtake the work and the die to start on.

After the threads are finished and the dies clear of the piece, the springs *C* and *K* serve to move the slide and rear spindle quickly to the right, so that the pieces may be changed. The belt shifter is operated by the movement of the slide so that with the stops once set all the attendant has to do is to put in the work and start the dies on by moving the lever *R*. The belt fingers are attached to a sleeve *W* which is pressed to the right or reversing position by a spring *N*. When the slide *T* is near its extreme position moving toward the right, the arm *G* strikes the collar *U* and causes the rod *P* to travel with it this through the lever *O* shifts the belts to run the spindles in the cutting direction and also compresses *N*. The rod *P* is held in this position by the latch *L* catching against the collar *V*. The limit of movement of the slide *T* toward the main spindle and therefore the stopping point of the thread on that end, is controlled by adjusting the rod *M* in the end of *G* so as to trip *L* at the proper point. When *L* is released, the spring *N* pushes the belts over to the reverse position and the dies run off. As soon as they clear the work, the slide *T* moves

to the right setting the mechanism ready for the next cut.

This machine is manufactured by the Webster & Perks Tool Company, Springfield, Ohio.

Education for the Machine Trades.*

BY SAMUEL M. VAUCLAIN.

I have been asked to address you upon the topic now before you, as to its relation to the apprentice boy, and therefore to the future of the mechanical industries of our country.

There is nothing so conducive to success in any manufacturing establishment as its personnel, from the president down to the watchman at the door.

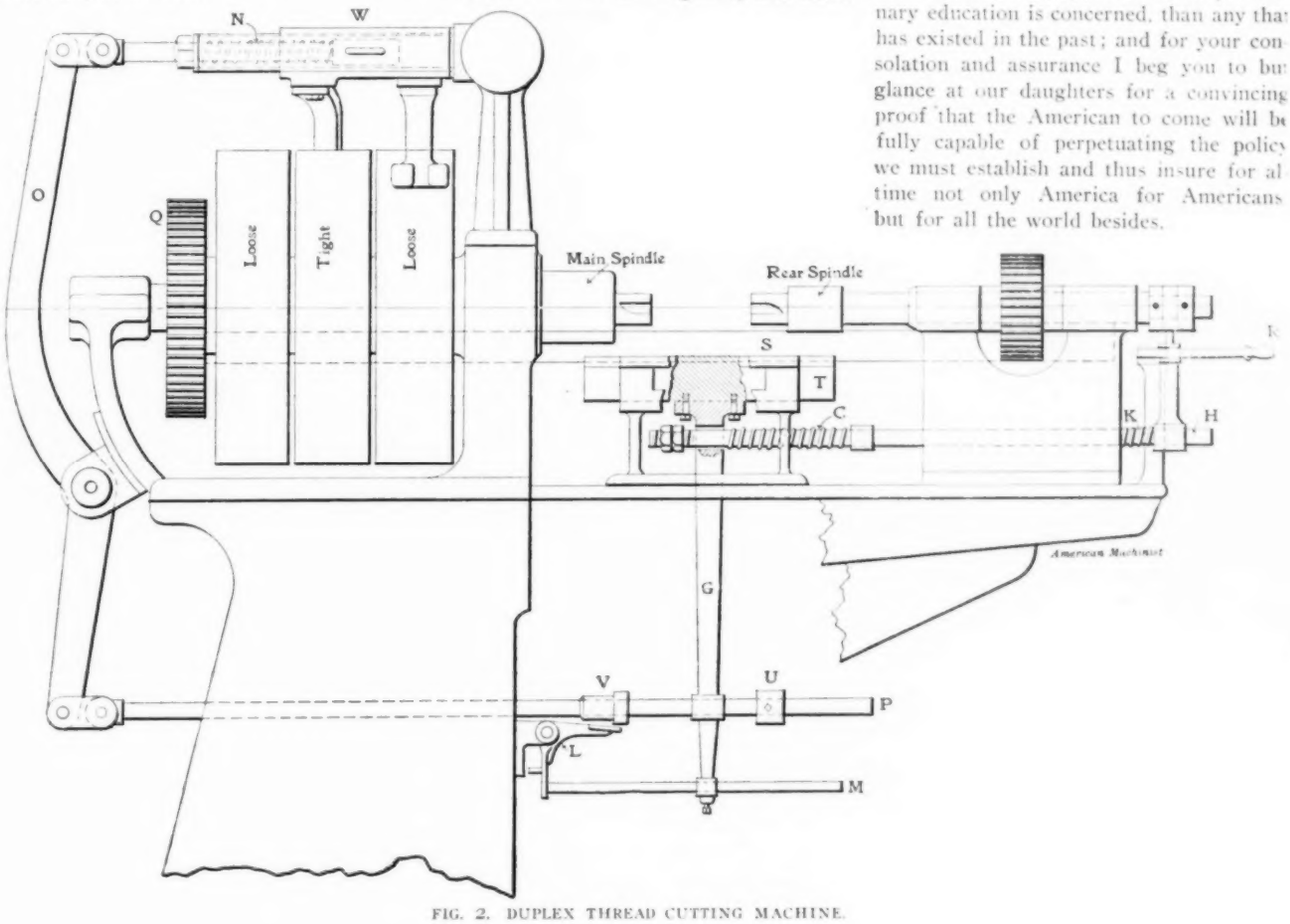


FIG. 2. DUPLEX THREAD CUTTING MACHINE.

A certain *esprit de corps* is necessary to insure success, and that in turn is dependent upon the education of the entirety. It is not my intention, however, to treat of that which is necessary for the many varied classes of employees, but to devote what little time may be at my disposal to the consideration of the education necessary for the apprentice. What an ocean of thought is necessary for his benefit! I have been asked, "Are the present or existing educational conditions satisfactory?" To which I can reply both "Yes" and "No." They are satisfactory in that they provide those who are permitted by their parents to attend our public schools with a rudimentary education sufficient to build upon for the future; also, in that they cause our high schools, both public and private, to daily charge the minds of young men with an excellent groundwork, the application of which to any of the various trades in the mechanic arts must insure success.

Also and more particularly are our colleges, several in number, engaged in the education of young men destined to fill many of the more important places in our manufacturing enterprises, provided their future may not be dwarfed by an overestimate of their worth.

And now as to the negative, and listen to me closely, in order that you may derive the full import of my perhaps not too clear explanation.

The education of our youth in the mechanic arts thirty years ago was conducted in a sort of "raised-by-hand" manner. The indentured apprentice was just ceasing to be, and the unindentured youth was being substituted in his place. The ambition of boys worthy of advancement was dwarfed by the favoritism practiced by superiors. The greed of gain and the struggle for distinction caused owners and their foremen to introduce labor skilled in but one thing—to work the youth of the land in such a manner, until, arriving at that age when red neckties and young ladies became attractive, a demand for better wages would be met by a rebuff or dismissal. Why have we our system of education as practiced by the public schools? Why do the high schools of our land exist? And lastly, why should we send our sons to colleges and other institutions of learning if they must buffet a condition so damnable to the youth of our land?

It is here that the educational system of our country is complete. The future of these great United States of America will depend upon the mechanical education of its youth. We are destined to be the workshop of the world. We have our mines of all kinds, our workshops great even in their infancy, and a generation before us better equipped, so far as preliminary education is concerned, than any that has existed in the past; and for your consolation and assurance I beg you to but glance at our daughters for a convincing proof that the American to come will be fully capable of perpetuating the policy we must establish and thus insure for all time not only America for Americans but for all the world besides.

Returning from this pardonable digression, I desire to say that in my opinion when our youth have left their schools and stand ready to enter upon their life's work, there should be a well-defined system pursued by the owners of all industries; not only should we revive the old system of indenture, but should improve it to meet the various grades of boys seeking places. The grammar school boy must receive even more attention than his more scholared fellows; his term of service will naturally be longer, but that which he may have lost at school will be more than made up by his better knowledge of shop practice and longer contact with men—men whom he must either mingle with or command.

* Read before the Engineers' Club of Philadelphia, by the General Superintendent of the Baldwin Locomotive Works.

Therefore, a series of indentures which shall suit the boys or young men of these three grades must be prepared, and must insure a regular and uniform progress in the art or mysteries of the desired trade, be it that of machinist, blacksmith, boilermaker, or other, and even though it may in some cases prove a loss to the individual, the whole will be benefited.

It may be claimed on the part of those intrusted with the education of our youth, prior to their engaging in any occupation intended to provide a livelihood for them and those to be dependent upon them in the future, that the so-called manual training schools of the country are sufficient and well adapted to educating and training a class of skilled workmen—skilled not only in the manipulation of machine tools, but thoroughly trained in the art of expressing their ideas upon paper in the shape of drawings, so that those thoughts can be transmitted to others sufficiently clearly to enable them to follow. It is in this manner only that the direction of thousands can be accomplished by a few. But while I do not wish to detract in any way from the good influence which may be asserted by the various institutions of mechanical handiwork, or so-called mechanical training schools, it is a fact that these schools are lamentably behind the times in all that appertains to the various trades as practiced in America to-day. The professors engaged in imparting knowledge to the various pupils in their charge are endeavoring to the best of their ability to discharge the obligations resting upon them. They are handicapped, however, by the fact that to be a successful teacher in this branch of education it is necessary to be in constant contact with the practical work of the workshops of the country, and to have at their command all the improvements that are made in the way of labor-saving appliances and improved methods of operation, so that when graduated their students may at least be abreast of the times and ready to proceed with their work in some one of the many great workshops of the nation.

The financial difficulty, however, interferes in almost every case, and in many of the workshops connected with the educational institutions of our country the machinery and appliances are lamentably deficient. It is my opinion that the money now spent by the various trade schools, mechanical training schools and others of this kind would be put to better use if devoted to a thorough teaching of algebra, geometry, mensuration, mechanical drawing and, if possible, some higher mathematics, sweetened and made palatable by an elementary knowledge of the chemistry of metals and their physical strength. If the workshops of our nation, already thoroughly equipped with valuable and efficient teachers, were organized as manual training schools—manual training schools that would pay to each student sufficient money to at least furnish him with the "bread of life," in place of, as in our present system, consuming his time without compensation and at a considerable outside expense; manual training schools that would carry along the successful student in such a manner as to eventually make him not only a success from the mechanical training standpoint, but a mechanic of the highest order—such schools would turn out young men not only trained from a thoroughly mechanical point of view, but so thoroughly trained on the commercial side of the profession as to make them a financial as well as a mechanical acquisition to our beloved country.

No one but those who employ labor or operate large machine shops are aware of the deplorable failures of those who enter their works from the mechanical training schools of our country. Give me the boy who has a thorough groundwork, a knowledge of the common branches taught in our grammar schools, a knowledge of the higher branches taught in the High School of this city and others of its kind, or a graduate of such colleges as Sibley, Stevens and the University of Pennsylvania, and I will be responsible for the mechanical education of these young men and for their adaptation to all positions connected with the various trades to be found in the industry with which I am connected.

Why is it that we cannot secure apprentices to the trades of blacksmith, boilermaker or molder with the same ease that we do to that of machinist? Can it be that our education, so called, gives the youth of our land a horror of such work, or is it not due to the fact that hardly an establishment in the whole United States offers any encouragement whatever to young men in these branches? They naturally shrink from the grime and the excessive manual labor; but these trades today, while bare of ambitious material for their perpetuation, offer the most desirable future for our youth, and in them the financial as well as the professional reward seems the greatest.

The Baldwin Locomotive Works, a quiet and well-ordered establishment doing business in a small way here in your midst, is endeavoring to start this great system of education. Among 10,500 toiling mechanics you will find more than a thousand young and ambitious men, variedly educated, toiling unceasingly for recognition and advancement.

They have before them other youths who have successfully rode out the stormy years of their aprenticeship and journey work, and are now holding positions of great responsibility. Why has the Baldwin Locomotive Works grown so rapidly within the last decade—almost fourfold its size? Three thousand men were then considered many, but the enterprise of youth and a system of persistent shop education as a continuation of that received at school have swelled the numbers, burst out the walls, driven out trade into every quarter of the earth, and to-day, gentlemen, you will find an army of men whose loyalty to their place of employment, energy of action and their susceptivity to direction are the admiration of all who visit those works.

It has been said that God made all men equal. In many ways this may be true, but not as to their capacity. We have daily born in the world those destined to command and those who must labor. It is true that many are drawn into the mire of error and despondence who otherwise would be a credit to our country, and it is to avoid this that we must all enter the arena of educators, and by daily contact sort out the youth of the nation, advise and direct, and so place and encourage them that they may all be successful comparatively, and add to the prosperity of the nation. The commander is seldom an investigator, the delineator seldom an inventor, the mechanical "crank," with whom you are all no doubt acquainted, fulfils his mission, an ever-present warning to young men suffering from their first megacephalous condition. Therefore, it remains for us to get to work faithfully and diligently, and at no little expense, to discharge our obligations and insure a continuance of our present prosperity to those who will follow hereafter.

In conclusion, let me tell you we must bear in mind that the greatest secret of success in our varied industries is to avoid family succession, excepting where it may have been successfully toiled for and earned shoulder to shoulder with other strugglers for the same end. When Mr George Burnham, senior member of Burnham, Williams & Co., owning and operating the Baldwin Locomotive Works, was asked to explain the success which attended his establishment, he replied, "There are no hereditary rights connected with the Baldwin Locomotive Works."

Let this then be the watchword of every manufacturer: It is far better to give your business to a competent stranger, educated under your own roof, than to entrust it to an irresponsible and disinterested progeny, not only from a pecuniary point of view, but for the betterment of humanity and the preservation of the industries of our country.

Letters From Practical Men.

Boiler Explosions.

Editor American Machinist:

At page 1361, Volume 24, I note the remarks of H. H. Lane in regard to the Penberthy boiler explosion at Detroit recently. Mr. Lane seems unable to account for the explosion in any way. I have not seen this exploded boiler, and do not expect to, but, as a boiler insurance inspector, it has several times been my lot to be sent to find the cause of boiler explosions as well as to "pay the freight." I have investigated several explosions that were really full-fledged explosions in which the

boiler was totally disrupted, as seems to have been the case at the Penberthy works, and, in the end, I have been required to furnish an opinion that would hold as to the cause.

When starting in on an affair of this kind the first thing is to find the *initial rupture*. By this I mean the point where the first break, crack or rupture took place. Assemble the pieces; recall that the strain on the longitudinal seams is exactly double what it is on the girth seams. Note the reduction of area at point of fracture in the plate, at or between the seams, or note shearing of rivets. If the rivets did not shear, find the fracture where the plate gave way and the material is at full thickness. In flange or firebox steel you will note the reduction in thickness at all points save where the initial fracture took place, and this reduction runs from 20 to 35 per cent. To better illustrate these points, allow me to quote a case:

A few years ago I was sent to "settle a loss" and find a decently reasonable explanation of it. It occurred in a good-sized Western town. The local men had divided opinions. One said the plate had been "reversed" in the bending rolls—*i. e.*, the outside had been rolled inside. This was silly, though he was a local "authority." Another said the well water used contained solids that set free gases which under certain conditions would prove explosive; which was nonsense, as the engines would pull the aforesaid gases out as formed. It seemed that the more darkly, deeply mysterious were the assigned causes the more readily were they accepted. The boilers were a pair of 66-inch by 16-foot horizontal tubulars, shell of ⅜-inch and heads of ½-inch plates, with fifty-four 4-inch iron tubes. The plates were stamped firebox steel. The shells were made of two sheets, one on the bottom and one on top, each sheet 16 feet long. Boiler No. 1 had exploded, and No. 2 was ruined in the act of trying to pass through the base of an 85-foot brick stack. No. 1 had let go at a longitudinal seam from head to head, the shell ripping away from the heads. We dug the shell out from the débris and found the fracture was between rivets on the inner lap. We could easily see by the reduction in area that the initial fracture did not start from the forward 12 feet of the seam, for all along this space the thickness was reduced from 25 to 35 per cent., while at the back end for 40 inches it was the full thickness. The pitch of the joint was 2.56 inches, which was correct for the size of rivet hole, 13-16 inch, basing the calculations on 38,000 shearing strength for rivets. What then caused trouble at this point? Well, some rivets cut from this point tell the story, as they were badly offset. There had been a slight error in laying out the holes. This had not up to 12 feet been serious, but as the seam was 16 feet long, it was bad for the rear 4 feet. There had been some trouble by leakage at this point and the joint had been calked. No rivets had been cut out to see if the holes were fair, for the boilers came from a good maker, were of good steel and were deemed high grade in every respect, and were only three years old. It is evident that the rivets tell the story in this case. There was a bad initial strain due to the drift pin and sledge necessary to get the rivets in place. Then the bending or flexure taking place in every lap joint that runs parallel to the axis of the shell had acted on the initially strained section for a scant three years, when the section gave way, the boilers having been operated at 115 pounds safety valve pressure. As the boiler had been presumed to be of special material and high grade, a factor of safety of 4 was used, based on the percentage rule. No inspection save cutting out rivets could have told that rivet holes were not fair, and I know of no boiler owners who are heroic enough to pay for such inspection. There were no other defects in this boiler, no other cause to assign—indeed with these data the matter was clearly explained to the minds of boiler men; but there was a property loss of $15,000 and a dead man to pay for, and we sweetly cursed that layerout.

In the cases of two recent boiler explosions in Chicago, in one the cause was failure at the longitudinal seam, the joint being double riveted, but the net section between the rivet holes being only 60 per cent., or but very slightly better than Fairbairn's 56-per-cent. single-rivet formula, and the initial fracture took place at such a seam. In the other explosion the pieces were not assembled for examination.

To recapitulate: There is a cause for every effect. Dismiss all the theories of gases in the boiler, search for the initial fracture, which, if all the plate is of full thickness, will be revealed by being full thickness. I assume no internal or external wastage has been found that would account for the explosion, and that bagging, low water or collapsed flues do not figure in the matter. In other words, I refer to explosions of plain tubular boilers at moderate or allowed pressures which are a mystery as regards the cause. A straight boiler explosion begins with an initial fracture and failure of the other parts quickly follows, but in this latter part of the explosion steel stretches, as in a test, showing it clearly at point of fracture by reduction in thickness that clearly indicates its desirability as a material, but decent treatment is demanded with no drift pin an ' sledge.

Mr. Lane should, in my opinion, rather plead for rivet holes punched to ½ inch, the plate being then rolled up and tacked together, and the holes reamed out to full size, the long seams having double straps and being triple riveted, rather than to ask for no boilers in a factory. If George Babcock had taken out a patent on horizontal tubular boilers built as above and built right, he would have made more money on them than on the water tube type, and they would have proved as safe as the water tube construction. When we recall the thousands of such boilers in use, built by the hundreds in shops that are in fierce competition for orders, and the great majority of buyers buying the lowest-priced one offered, without consideration that punching is cheaper than drilling and 20 per cent. weaker; that a lap joint costs $2 a foot less than a butt strap—when we recall all these facts we may congratulate the boiler makers that of the vast number of boilers in use so few prove of faulty design or explode through careless work. The buyer should call for and be willing to pay for drilled holes in place of the uncertainties of punched ones, and do away with the lap joint, using instead the butt strap double plate triple riveted joint.

Of the rivets, one shows more offset than the other, having been nearer the back head. They are cut from the seam at the point of initial fracture. Others were cut out throughout the seam, with results that fully proved the error in laying out. Of course none of the facts as given were made public at the time or till now, and they are only given now that perhaps the facts may aid in the search for causes in some future explosion. DUPLEX.

[Our correspondent is a man of large experience in these matters, and his views are of corresponding interest. We must say, however, that they are the exact opposite of what we would expect. It seems to us that the initial rupture would naturally be the one to show reduction of area and that the secondary ruptures would, as naturally, show none or, at most, but little. —Ed.]

Universal Commutator Bar Gage.

Editor American Machinist:

Having been a reader of the AMERICAN MACHINIST for some years and read with great interest some of the articles on special tools for special jobs, while others I have been content to glance at and pass on, as I suppose must be so with most of the readers, it has occurred to me that there may be a sufficient number of readers interested in the subject to warrant the publishing of the following article describing a commutator bar gage which I designed and made several years ago to enable a small shop to turn out commutators to advantage, as it proved to be a happy solution of one of the several problems connected with the commutator question.

We built dynamos and motors from ¼ to 75 horse-power. Of the small sizes we often had to make commutators in lots of 20, while the larger sizes were more likely to be in lots of 2. The outside diameter was never over 12 inches and the number of parts in a commutator might be anything from 20 to 100.

Our method of construction required that the inside diameter should come near enough so that when the required number

of bars were set up with the mica between them around the commutator bushing and the end rings were tightened, the whole thing would become solid, the mica between the bars being pinched firmly and at the same time the inside edge of the bars resting firmly on the insulation between the bars and the bushing, as shown in Fig. 2, otherwise the commutator would not stay in shape after it was finished.

That was the construction this shop commenced on for very small commutators with few parts. At first we sawed them from copper cylinders and the problem then was to put just enough mica between the bars to fill the space that the saw made, and if we missed it the first time it was only a short job to pull the commutator down and make the mica thicker or thinner as required, but as the diameters grew larger and the number of parts increased the troubles multiplied rapidly. The things we learned and unlearned about sawing copper alone would make an interesting story to anyone who might have that kind of work to do, but of very little interest to anyone else. The time came when we had to make each bar separately, the thickness and the angle of the side depending on the diameter and number of parts, of course. The sides, ends and bottom had to be milled, and the problem was to mill a given number of bars to such a size and shape that with a given thickness of mica between them they would all set up around the shell and pinch the mica between and the insulation under them equally and have it come right the first time.

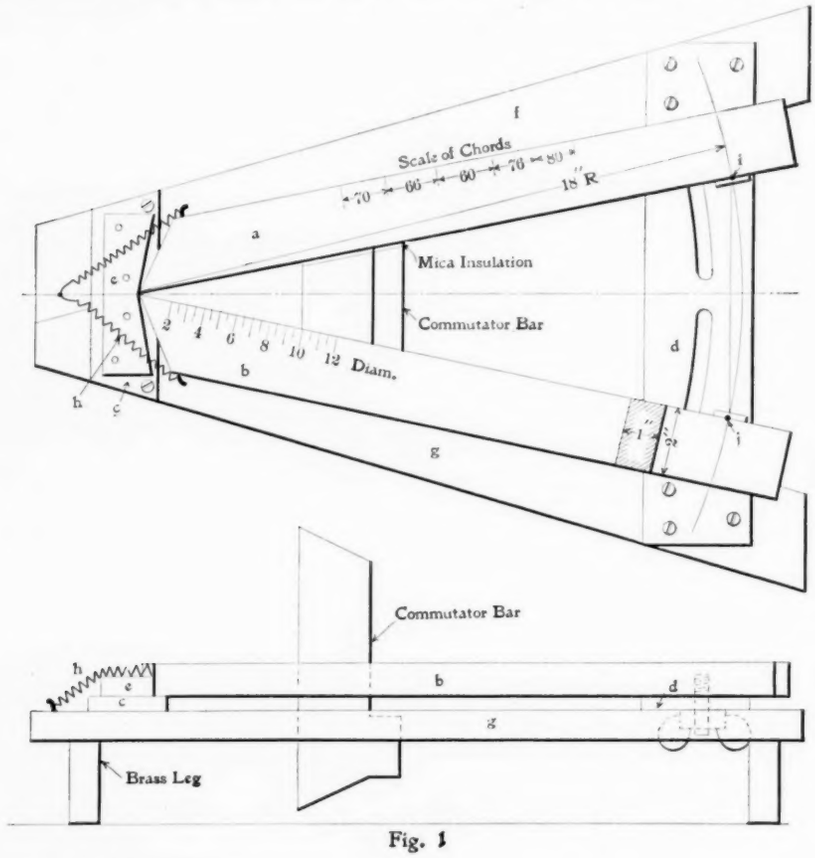


Fig. 1

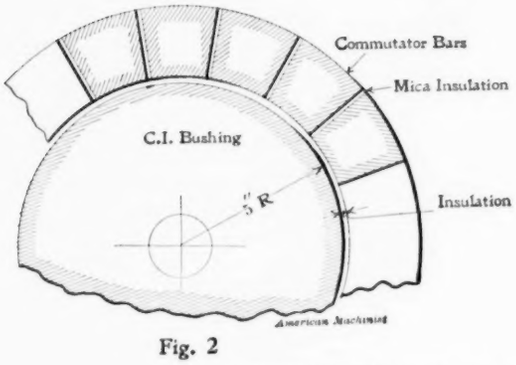


Fig. 2

UNIVERSAL COMMUTATOR BAR GAGE.

I am not going to tell all the things we tried that did not give satisfaction, but am coming to the subject of this article, the universal commutator bar gage. It consisted of two radial pieces of cast iron *a b*, Fig. 1, about 20 inches long, of rectangular section about 2x1 inch, finished all over and the ends beveled. These were mounted on two pieces of cold-rolled steel *c d*, the points resting against a third piece of cold-rolled steel *e* riveted to the top of piece *c*. The piece *d* had two slots concentric with the points of the radial pieces through which slots passed 5-16 inch studs with wing nuts to bind the radial pieces to pieces *c d* and hold them at any angle that might be required. The whole was then mounted on top of two strips of hardwood *f g* about ⅞ inch thick and fastened with wood screws. The points of *a b* were held in position by a single coil spring *h* doubled in the middle and hooked to three pins, one in the wood and one in each radial piece, as shown. On the inside edges of *a* and *b* 18 inches from the points were fastened small pieces of metal and then exactly on the inside edges and 18 inches from the points of *a* and *b*, as nearly as could be measured with a steel scale, very small prick punch marks *i* and *j* were made. Piece *b* was graduated for 6 inches from the point on the inside edge by a common scale, but in making the figures each inch was marked twice its value on the scale in order to read for diameters instead of radii.

Piece *a* was laid out into a scale of chords which had to be found for every different number of parts mounted in a commutator, but once found and laid out on this scale and properly marked, it was an easy thing to set the gage to the right angle. Whether we took the best way to find these chords or not I am not going to say, but we did it with the tools we had at hand and we did it sure. The tools required were a sharp pair of dividers, a pair of tram points and a large sheet of the smooth, hard fiber used for insulating purposes and to be found around every shop of this kind. On this sheet was struck a 36-inch circle which was divided with the dividers into the number of parts required. Having the dividers once set by this method we carefully laid the distance between the points off on the scale of chords on piece *a* and marked it. This once done it was only necessary to take this distance on the dividers from the scale of chords to suit the number of segments and set the two pieces *a* and *b* so that the dividers would just span the distance from point *i* to point *j* to set the gage to the angle required. This was carefully done on the 18-inch radius and as the radius of the work was never over 6 inches, the error was so small that the results could be depended upon for this kind of work.

This tool was not a nice-looking one and very few toolmakers would like to own that they had made such a looking thing as it was, with its mixture of cold-rolled steel, cast iron, wood strips, brass legs made from an old brush stud, and no finish where it could be omitted, and I would not have made such a looking

thing under any other circumstances, but something had to be done and that right away; and this mongrel-looking affair served its purpose so well that I grew quite proud of it. I know that it was in constant use over three years and I only wish that all the other tools I have designed had served their purpose as well, and some of them looked very nice and cost lots of money.

A TOOL MAKER.

A Rig for Cutting Steep Pitch Worms.

Editor American Machinist:

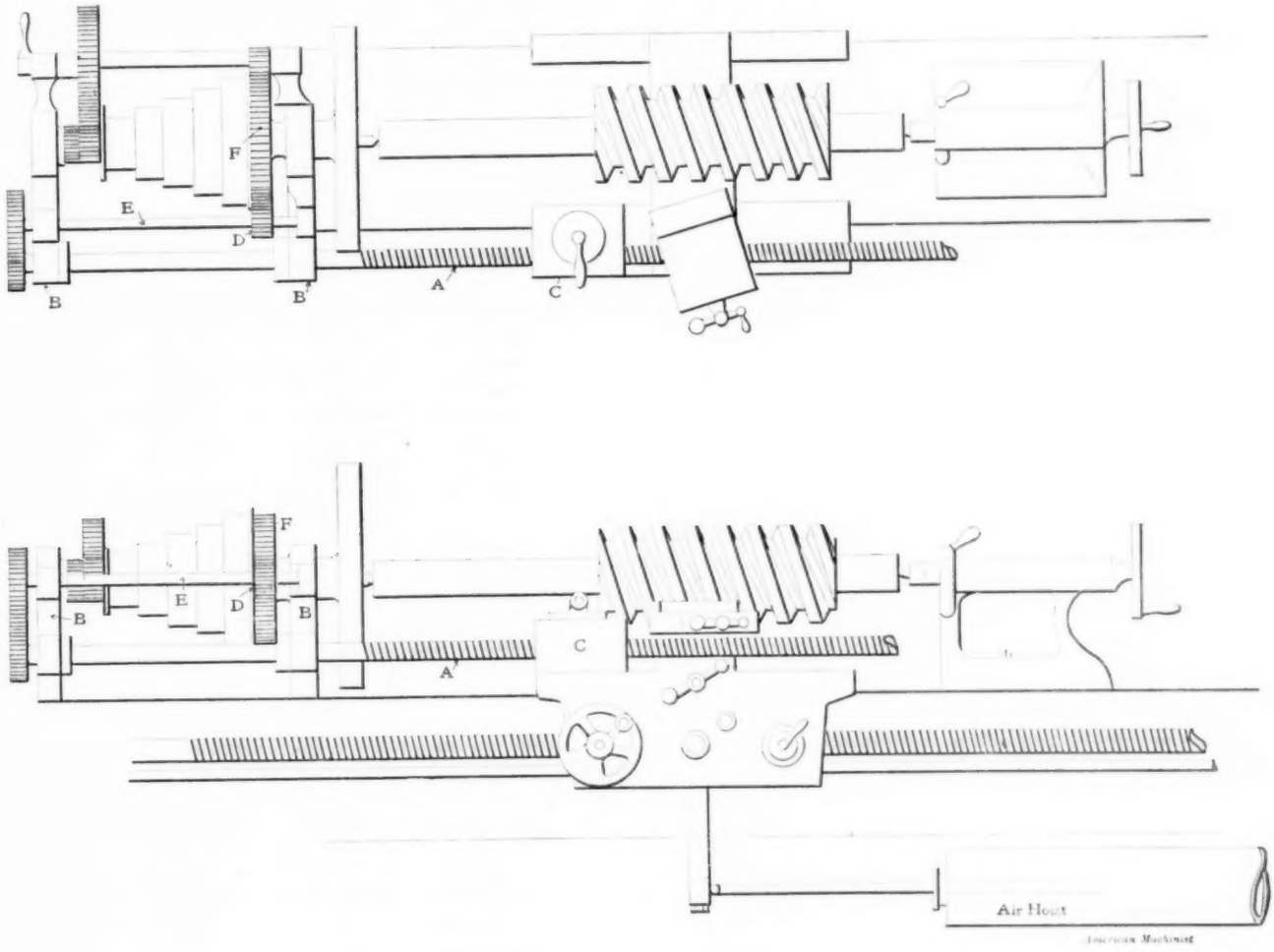
I saw a lot of big worms turned in the lathe some time ago in a way that proved quick and satisfactory. This is always an interesting subject, and I will try to describe the method to the best of my recollection.

The lathe used was a 36-inch swing, 20-foot bed and had a compound rest. A short lead screw *A* was made of suitable length, the head end resting in the brackets *B*, fastened to the headstock, the other end running in a box fastened to the tailstock or shears. The half nuts were in a box *C* fastened to the left-hand end of the carriage. A pinion *D*, feathered to the shaft *E*, meshed with the spindle back gear *F*, giving a stud ratio of 3, 4 or 5 to 1. The shaft *E* was called the stud, and it also journaled in the boxes of *B*. Change gears were put on the free ends of *A* and *E*.

Instead of running the carriage back by hand, an air-hoist was fastened to the front of the bed, the rod being connected to the apron somehow or other, and the valve conveniently located. At the end of a cut the half nuts were opened, and the tool withdrawn by the cross-slide only. Air was admited to the hoist cylinder, thus bringing the carriage back to the starting point, when the valve was reversed the cross-slide advanced to a stop, the tool fed in to the proper depth of cut by the compound rest and the half nuts closed at the proper moment.

This rig was a great success for knocking out quantities of steep screw work of any form, and a few suggestions are in order: The pinion *D* should be feathered so that it may be slid to the right on the shaft *E*, thus throwing the rig out of action, so that the work may be turned and the ends finished, as the rig in no way interferes with the regular work of the lathe, nor are the feeds or change gears molested. The valve of the air hoist might be advantageously operated by foot, but at any rate should be so arranged that air cannot be admitted to the cylinder when the carriage is near the tailstock. At this point the cylinder should be open to the atmosphere, otherwise the workman might have the screw pulling one way and the air hoist the other, and something disagreeable might happen. For roughing the thread, common cut-off tools should be used, and their nose width should be slightly more than half the width of the thread space at the root. The tools should be fed in at an angle of 14 degrees, thus allowing a little for finishing.

If the worms are all pitched a multiple of ¼, then cut the lead screw 3 per inch, and you need not miss half a dozen revolutions waiting for chalk marks to coincide. If, when cutting the first thread of an octuple worm, the carriage can be returned in time to catch the third thread, cut that and follow up with the fifth and seventh, then miss one and catch the second, fourth, sixth and eighth. After which feed the tool forward for another cut, by means of the compound rest, take in order the second, fourth, sixth and eighth threads, then miss one and take first, third, fifth and seventh. When working on long multiple worms the men generally mark the numbers 1, 2, 3, etc., on the worm and also on the carriage with chalk. Each time a cut is taken through a certain number of thread, the number on the carriage is



A LATHE ARRANGED FOR CUTTING STEEP PITCH WORMS.

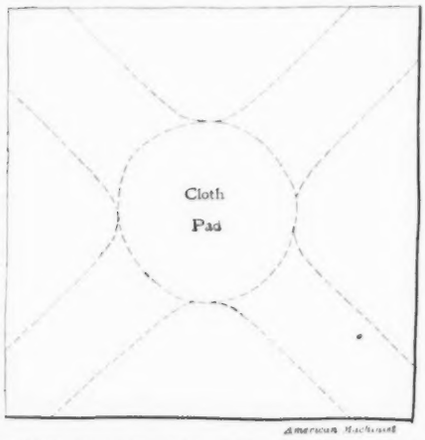
erased; this always tells a man where he is. He does not take a wind cut through one thread and break the tool on the next. The above rig was for cutting worms from 4 to 18 inches diameter, 6 to 30 inches long, ½ to 2 inches pitch and ½ to 12 inches lead. WM. H. BROOKS.

Chicago.

When the End of Your Finger is Sore.

Editor American Machinist:

I have had my share of sore fingers and have bothered with all kinds of bandages, but when the wound is on the very end of a finger I always have observed that it's a very inconvenient place to cover and make the bandage come down to a comfortable fit. The usual way is to get a square or round piece of rag, put the cut end of the finger in the center of the rag and double the volume of rag down over the body of the finger, making a rig not unlike a rag baby, and looking so bulky that all your friends suppose you are seriously hurt, and you are questioned on every side.



CLOTH WRAPPER FOR THE END OF A SORE FINGER.

A few days ago I was fooling around a little machine and talking with the man in charge and I carelessly lost a nice little bit of cuticle off a finger end. I know enough, at my time of life, to speedily get a bandage on a wound, even if I don't know enough to keep from getting hurt. I found the material for the bandage all right and I did it up in the good old-fashioned rag-baby way, but when night came and I wanted to get a more symmetrical dressing an idea struck me how to cut a rag that would do the job just as effectually and make a neat and smooth bandage: Take a square piece of suitable cloth, as in the sketch, and cut to the dotted lines. If you want a pad right on the very finger end, put one or more round pieces in the center, as per sketch, and apply. The four legs of the rag, if cut properly, will nicely enclose the body of the finger, and a narrow piece of cloth wound around over all will make so neat a job that the finger won't look sore from the outside, and one can wear a glove with comfort. F. P. AVERY.

Tunkhannock, Pa.

Breaking in Steel Lettering Pens.

Editor American Machinist:

Every draftsman knows how steel pens improve after they are broken in, and how it often takes a year to get a steel pen to do smooth work. Mr. C. H. Burnside, a co-worker with me at the University of Wisconsin, recently broke in a number of pens on an oil stone by writing the common strokes thereon until the pen attained the required smoothness. Later he has used simply a little bottle of No. 120 ground emery, and jabs the pen into this tightly packed emery, thus in a few moments wearing the pen into a surprisingly fine writer or printer. With a little practice one will find these "kinks" very useful.

OLIVER B. ZIMMERMAN.

[Sometimes a few strokes on an oil-stone with a good writing pen will improve its action, though a few too many are liable to ruin it.—Ed.]

The Opinions of Machinery Manufacturers on Reciprocity and Foreign Trade—II.

Last week we commenced the publication of letters from prominent machinery manufacturers on reciprocity and the American foreign trade in machinery. These letters were received in answer to a circular letter of inquiry sent out by us (printed at page 242), and we here continue the letters, which will appear from week to week until all have been given.

Hugo Bilgram, manufacturer of gear wheels and machinery, Philadelphia, Pa., says:

"In studying the tariff question I have arrived at convictions which in many respects are at variance with the generally accepted views.

"Commerce being an essential factor in the specialization of industries, an obstruction to commerce, such as tariff, is in a sense equivalent to a resistance to the introduction of labor-saving devices or to a condemnation of inventive efforts. Why should we fear competition? Foreign labor is admittedly cheaper than domestic labor because, and only in the measure in which, it is less productive.

"Our desire to export more than we import can be traced to our desire to make other countries our debtors and to obtain from them a tribute in the form of interest on bonds, dividends on stock or profits on invested capital. The country in which a low rate of interest prevails will always export to the country of high interest rates. For this reason low-interest countries will desire reciprocity and even free trade, while high-interest countries will favor high tariff to stay the inevitable importation of foreign products and the subsequent investment of the purchasing price. Tariff can accordingly protect only investors of capital. Labor cannot profit by it, for it tends to increase wages only in the measure in which it tends to increase prices. The wages, expressed in dollars and cents, may be increased by tariff, but the purchasing power of this increased sum will not be greater than that of the smaller sum. The only advantage of tariff is its tendency to prevent money from leaving the country and to keep competitive capital out, unless that capital is imported in the form of gold coin or bullion. Tariff is a relic of the mercantile theory of economics, which places more importance on money than on wealth consisting of labor's products. Indeed, by our indifference we have permitted the perpetuation of some very objectionable currency and banking laws, which have the tendency to even now give supremacy to money. And by tracing the deplorable effects upon our industries of this supremacy to wrong causes, the most absurd notions on economic topics, including the tariff question, are apparently confirmed.

"However, tariff cannot be shown to foster monopolies. It cannot prevent competition within the country, and cannot, therefore, impart to anyone a power to acquire profits where that power does not exist from other causes. The damage done by tariff is comparatively small, and more importance is attached to this subject, both by its advocates and by its opponents, than it deserves."

The Billings & Spencer Company, manufacturers of machinists' tools and drop forgings, Hartford, Conn., say:

"We believe in reciprocity. We think it would be advantageous to the manufacturers of this country if we had free raw material, and also in our own business it would allow us to produce our goods much cheaper. We think it would keep the price more uniform. We do not know of any country where workmen produce more for the pay they receive than they do in the United States, and we quite agree with our lamented President McKinley in his last address at Buffalo, as set forth in your circular."

The E. W. Bliss Company, Borough of Brooklyn, New York, manufacturers of presses, dies and special machinery for working sheet metals, machines and tools for rolling mills, railroad shops, etc., say:

"We need a protective tariff, perhaps not so much in our own particular trade, which is a special one, as for the benefit of the many trades represented by users of our machinery. If our tariff laws benefit them and increase their business, we, in turn, are benefitted by their wanting our machinery to increase their own production. It seems to us that an opinion on the tariff question should not be arrived at by simply looking at its effect upon one's own trade alone, and that such a view is too narrow. Such tariff regulation as will make the country prosperous as a whole cannot fail to benefit all trades making up that whole. We think tariff rates need constant revision, according as conditions change; but, in our opinion, the principle of a protective tariff high

enough to protect home manufacturers but low enough to discourage monopoly should be maintained. If we find monopolies in possession of certain lines increasing prices, not warranted, simply because home competition has been brought up, and the tariff is high enough to exclude foreign competition, the remedy lies with Congress to 'make the punishment fit the crime' by changing such tariff rates until such monopolies and all others like them understand that a protective tariff must be used only for the benefit of all the people by whose favor it exists, and that when it appears to exist solely for the benefit of some grasping corporation that has gained control of the market and is charging exorbitant prices for its product by reason of the protection of such tariff, it will take off the duty and let the foreign products come in free as a penalty.

"Question 2. 'Do you think the present high tariff has a tendency to retard foreign trade?' Ans. If it does we do not see any evidence of it.

"Question 3. 'Would free raw materials allow you to produce your product cheaper?' Ans. Raw materials with us are coal, pig iron, and bar iron and steel. If coal came in free, we cannot see that it would be any cheaper. If iron and steel came in free, it might reduce the cost somewhat; but if it injured the business of the iron and steel makers in this country, it could not fail to injure us much more than we would gain by letting these articles come in free.

"Question 4. 'Do you think that free raw materials would tend to keep the prices of such materials more uniform?' Ans. Possibly so, but the most prosperous times we have ever known have not been times of low prices. On the contrary, they have been the times of high wages, large demands for goods and high prices. In times of adversity the rule has been low wages, idle men, low prices for goods, but no money to buy.

"Question 5. 'Do you know of any country where workmen in any line do more for a dollar in pay than they do in United States?' Ans. Not in our line. We cannot answer as to other lines.

"We have again read the words of the late President McKinley, and with those words before us we sum up the question of foreign trade as follows: The greatest market this country will ever have is its own. All the trade it can get in addition to this market will be so much gained, but our policy should not be such as will jeopardize our home market by opening it to foreigners for the sake of getting a foreign trade that will not make up for what we may lose at home."

R. H. Brown & Co., New Haven, Conn., manufacturers of patent expansive bits, screwdrivers, drill chucks, tools and gages for interchangeable work, special machinery, drop forgings, book stitching machines, etc., say:

"In reply to the question No. 1, 'Do you need a protective tariff in your own particular business?' our reply is, No. In reply to second inquiry we are inclined to think that the high tariff does retard foreign trade. Replying to inquiry No. 3, we doubt if free raw materials would make much difference in cheapening production with us. Replying to inquiry No. 4, we are inclined to think that the uniformity of price on raw materials would be governed a good deal by the supply. Replying to inquiry No. 5, would say, No."

Brown & Sharpe Manufacturing Company, Providence, R. I., manufacturers of machine tools, small tools, gages, calipers, steel rules, etc., say:

"We fear it is unfortunately true that the success of our manufacturers abroad during the past few years has not taught us to have a perspective of the real state of affairs. We firmly believe that the success of our machinery exports has been primarily due to the superiority of American designs, aided, no doubt, by an abnormal demand and the consequent crowding of the foreign shops. But of late the foreigners have learned a good deal from us, and are in a good position to offer designs approaching the American, which fact we must reckon with in the future. Owing to a growing hostility to American competition, we will do well to preserve all the advantages which we have earned, even at the expense of some of our cherished ideas as to a 'protection' which at the best is doubtful. It is better, we feel, to forestall any possible action of European nations by removing duties here and there which will not unwarrantably provoke our neighbors, as is surely the case in the present state of our tariff. For this reason we feel that President McKinley, when he spoke the words at Buffalo which are so well known, spoke only too truly, that 'the period of exclusiveness is past'; and if we refuse to recognize the force of these words, perhaps we shall be affected in the machinery trade as soon as in any other.

"As for the effects on the machinery business of the protective tariff, free raw materials and the matter of wages, we have too much confidence in the ingenuity of American designers and the competence of their workmen to feel that they cut much of a figure."

Buffalo Forge Company, Buffalo, N. Y., manufacturers of forges, blowers, exhaust, heating and ventilating fans and systems, say:

"We heartily endorse the words spoken by our late President, William McKinley, in his last public address at Buffalo. We favor and encourage reciprocity.

"Our business has grown and been perfected to such an extent that we no longer need protective tariff. We not only compete favorably in domestic markets, but successfully in foreign markets as well.

"Free raw materials would not allow us to produce our products at a lower cost, nor do we believe that it would keep the prices of raw material more uniform. The skill of the American workmen enables them to do more work for a dollar in pay than workmen of any other country."

The Builders Iron Foundry, Providence, R. I., manufacturers of grinding machinery, center-shafts, "Venture" water meters and general machinery, say:

"We most heartily agree with the view of the tariff situation as expressed by the words you quote from President McKinley's last public address.

"Occasionally a protective tariff has been of benefit to us, but we think it can be materially reduced, and that usually its advantage has been indirect in promoting the prosperity of some of our customers, rather than by directly benefiting ourselves.

"We believe that the present high tariff retards foreign trade, and that free raw materials would tend to cheapen products and keep prices more uniform. We believe the workmen of the United States are more efficient than those elsewhere; but we appreciate that our best efforts will be required to meet competition, especially with the Germans.

"We hope that the tariff, as a whole, may be reduced, and that reciprocity treaties will be enacted, and we think that the system of maximum and minimum tariffs is a feature of such treaties that is well worth careful consideration."

E. P. Bullard, president of the Bullard Machine Tool Company, Bridgeport, Conn., manufacturers of boring and turning mills, lathes and other machine tools, says:

"I am in full accord with the sentiments of the late President McKinley as expressed in his last public utterance, from which you quote.

"It is evident that the trade expansion of the past five years had been effective in converting him from an extreme protectionist to a man of liberal and comprehensive views. He realized what so few seem to, that international trade is but barter on a large scale; a simple matter of 'so much for so much'; that with trade, as with the ocean, the tide must ebb as well as flow. It is to be hoped that the logic of events will soon have a like convincing effect upon our manufacturers, and through them upon our law makers.

"You ask if we need a protective tariff in our business, to which I answer most emphatically, no. Our present high tariff is, in my judgment, a serious barrier to larger trade relations with peoples, whose friendship we could cultivate to mutual advantage. 'The period of exclusiveness is past.' The times are ripe for pressing this great truth to the front so impressively that men's minds shall grasp its full force and meaning. If this is done intelli-

gently and persistently the results must be a loosening of the bonds that now restrain our industrial activities.

"The practical adoption of the gold standard, together with the large increase of capital, has put our industries on a firmer footing than ever before; therefore, with a free hand in the matter of raw materials of all kinds we should have no fear as to the results of open competition with all the world; but the present policy of exclusion from our markets will soon result in a like exclusion of ourselves from the world's markets—as witness, the tariff agitation in Germany and the retaliatory measures actually being enforced by Russia.

"It was my pleasure to attend the recent so-called Reciprocity Convention held in the city of Washington. All discussion of free trade was rigidly suppressed; but the most extreme protection theories and facts (?) were vociferously applauded. I soon reached the conclusion that a mistake had been made in the call, which should have been for a national anti-reciprocity convention. At all events that, as we all know, was the net result.

"I should be pleased to have a convention called avowedly in the interests of freer trade relations, but in which the fullest discussion of all views could be had.

"To-day 'protection' may have value for a few, but in the main it is obstruction for the many."

W. F. Warden, general manager of The Burt Manufacturing Company, manufacturers of the Cross oil filter and purifier, Akron, O., says:

"I believe in reciprocity as expressed by our late President McKinley in his public address at Buffalo. The people of this country will realize more fully the wisdom and sound sense of this address in future years than they do now.

"It is the writer's opinion that it will be impossible for the manufacturers of this country to continue to export such enormous quantities of machinery in the future as they have in the past, for the reason that the manufacturers of foreign countries will endeavor to have restrictions of all kinds placed upon the goods coming from this country.

"We hope to see a very conservative law passed granting reciprocity to certain countries when clearly shown that such a law is necessary to hold the trade of our manufacturers."

The Cincinnati Planer Company, manufacturers of planers, Cincinnati, O., say:

"We are of the opinion that the machine tool trade of America does not require a high protective tariff, and believe that foreign countries in framing their tariff laws discriminate against American-made machinery by reason of our present high duties. The time has certainly come when a few stones removed from our tariff wall would be beneficial; the fortified position which we occupy to-day is displeasing to our neighbors; if we wish them to buy our goods, then business courtesy demands a like oportunity for them."

The Cincinnati Shaper Company, manufacturers of machine tools, Cincinnati, Ohio:

"We are thoroughly in accord with the quotation from our late President McKinley's address at Buffalo.

"We do not think that there is any need for a protective tariff at present upon machine tools. We feel, too, that high tariffs against other countries are apt to result in retaliatory legislation, and if possible they should be very much modified or taken off."

The Cincinnati Machine Tool Company, machine tools, upright drills, Cincinnati, Ohio:

"We fully agree in the sentiment expressed in the quotation you make from President McKinley's Buffalo address, and as stated recently to the Manufacturers' Club here in this city we believe the time for reciprocity has come. We do not think that a tariff in our particular trade is necessary, and naturally believe that the high tariff at the present time has a tendency to hold back foreign trade. We believe, on the other hand, that the conditions abroad are not such as would bring about much business, and believe that it will be some time before there will be a revival.

"We beg to quote from a letter just received from a dealer in Germany as follows: 'We are aiming at a reduction of our large stock of machine tools and beyond doubt the trade or import of machinery is crippled for years to come.' With such conditions existing, we do not believe that tariff legislation will help matters along, and think that the general conditions of such a country will certainly have to improve before we look for any of their business. On the other hand, some of the countries in which the conditions are better might be benefited by a more liberal policy of dealing."

The Cleveland Pneumatic Tool Company, manufacturers of pneumatic tools and appliances, Cleveland, Ohio, say:

"We do not believe that we need a protective tariff in our particular trade. It is our judgment that the present high tariff has a tendency to retard foreign trade in some particulars; or, in other words, quite a number of commodities could stand a considerable reduction of tariff rates without any injury to the manufacturer. Free raw material would not make any difference with our production as to making it cheaper. We believe that by allowing raw material to enter free it would have a tendency to keep prices on such materials more uniform than they are at the present time.

"We do not know that there is any country where workmen do any more for a dollar in pay than in the United States. Some foreign countries are able to obtain workmen at a much less wage than is paid in this country, but whether they produce more for the amount of money paid, is a question which we are not at this time prepared to answer.

"The late President McKinley said in 1884 that the time would come when the tariff duties would have to be lowered on a great many lines of manufacture, and we believe that time is at hand.

"The great inventive genius of the American people is such that we believe we will be able to produce any kind of machinery now made, at a much lower actual cost than it can be produced by other nations, and therefore the wage earner will obtain better wages than are paid by manufacturers of other countries.

"We believe in reciprocity. For the purpose of protecting the lumber and salt industries of our own country against our Canadian cousins, all other lines of manufacture are obliged to be cut out of that market on account of the duty.

"Every manufacturer sees these things from an individual standpoint, but the laws should be framed so as to do the greatest good to the greatest number."

J. D. Cox, writing for the Cleveland Twist Drill Company, manufacturers of twist drills, reamers, etc., Cleveland, O., says:

"We heartily endorse the words spoken by the late President McKinley in his last public address at Buffalo. We think the day has long since passed when the manufacturing interests of this country need a high duty fence built around them.

"Most emphatically we do not need a protective tariff in our particular trade. The American manufacturers of our line of goods supply nine-tenths of all the goods of this class used in the world. There are cheaper goods made in Germany, but the quality does not compare with any of the first-class American makes.

"We do believe that the present high tariff has a tendency to retard foreign trade. Since the ruling of Secretary Gage on the Russian sugar tariff question the export of our class of tools abroad has fallen off at least 50 per cent. Free raw materials would very greatly assist the manufacturers in our line of business, as we are obliged to pay the tariff on tool steel in addition to the cost of manufacture and profits. With the tariff on the tool steel removed we could most certainly buy our raw materials cheaper.

"As to the prices of raw material being more uniform without tariff, I cannot feel sure. There has been very little variation in the price of high grades of tool steel in the last six or eight years.

"As to the amount of work done per man in America as compared with other countries, I am free to say that, so far as my observation goes, every workman in

the United States does less manual labor but accomplishes more through our shop systems and through the improved machinery used here than in any other country in the world; but I regret to note a growing tendency upon the part of labor unions to curtail the amount of work a man shall do, regardless of how perfect the appliances are with which he has to work."

The W. P. Davis Machine Company, machine tools, engines, boilers, tools and supplies, Rochester, N. Y., say:

"We believe that President McKinley spoke the truth in every particular as to what you quote in your letter. We believe in a certain sense the same relations exist between two nations that exist between two individuals, and it is an unwritten law in business that we help those that help us.

"We believe that this is in every sense the position of nations as well as individuals. There may be conditions, for a certain length of time by which it is to the advantage of one nation to buy of another, but within a reasonable time they must see that we appreciate such efforts on their part and reciprocate in some manner.

"As to how the direct result can be brought about between the various nations, is a different question and hard to solve. We think, however, that reciprocity is the key, but how it can be best brought about is something that would be hard to determine. We do not believe that in our own business we need a high protective tariff.

"So far as we are able to judge, we are paying better wages for the number of hours worked than any other country in the world; but to offset this we have the greatest general intelligence among our skilled mechanics, for the reason that they are better educated. Any skilled mechanic here can live in comparative comfort and have all of the advantages that can be obtained by the best of reading matter. It is said that 'knowledge is power,' and there is no place where it will apply more effectually than in manufacturing machinery.

"We do think a high tariff will retard foreign trade. If we boycott, so to speak, foreign products, they in return will get back at us in some manner.

"We do not think that free raw material would make much difference as to uniform prices, as competition is so keen in every branch of business that it will adjust itself.

"We do not believe there is any country where a skilled mechanic produces more for a dollar than in the United States."

The Detrick & Harvey Machine Company, manufacturers of open side iron planers, bolt threaders, nut tapping machines, Baltimore, Md., say:

"During the past few years we have done a large export business, but the last year it has fallen off considerably. We believe that reciprocity and a general reduction of the tariff would be of material assistance to us in the enlargement of our foreign business."

The Diamond Machine Company, manufacturers of grinding and polishing machinery, Providence, R. I., say:

"We were much pleased when we read the words you quoted from President McKinley's address. It seemed to us to express the position which should be taken by the head of the nation.

"We do think the present high tariff has a tendency to retard foreign trade.

"Free raw materials would probably allow us to produce our products more cheaply.

"We do think that free raw materials would tend to keep the prices of such materials more uniform.

"We do not know of any country where workmen in any line do more for a dollar in pay than they do in the United States.

"We think the tariff should be reduced on all articles which are freely exported from this country, and is the most probable step to that liberal reciprocity treaty.

"The present tariff situation between Russia and this country we consider extremely unfortunate, and we think that legislation towards Russia should be especially liberal. The French treaty also requires very careful consideration."

Dreses, Mueller & Co., manufacturers of machine tools, Cincinnati, O., say:

"We are fully in accord with the expression of the late President McKinley. This country cannot expect foreign nations to buy from us for a length of time while we surround ourselves by a Chinese wall of tariff duties. Many must have our cereals, but by no means does their existence depend upon our machinery. While it would be unwise to abolish the duty on machinery altogether, a liberal reduction should be made. As we are undoubtedly paramount in the manufacture of machinery, we do not need the present high tariff. A reduction in the duty would likely check the agitation for higher tariff now on foot in some countries in Europe, who use our own high duty as a pretense to raise theirs.

"Under entire free trade the prospective market in our own country would stimulate smart competition from Europe, and by their cheap labor and applications of our methods their success could not be doubted.

"Free, or only a moderate duty on raw material will evidently keep the price of the same at a legitimate level, and not in accordance with the dividend paying on the high capitalization of some of the producing interests. It would further cheapen production of machines and make easier competition for us in foreign markets."

Emmert Manufacturing Company, manufacturers of Emmert's universal vises, Waynesboro, Pa., say:

"Our lamented President struck the keynote in his last public address at Buffalo. Since we are compelled to mourn our untimely loss, we rejoice that he was permitted to live long enough to find the proper level on the question of tariff. In our business the present tariffs practically exclude us from the world's markets. Reciprocity in tariffs and reciprocity in commerce work upon the same lines, only that the one repels and the other attracts. A tariff sufficient to cover the difference between the cost of a foreign product laid down at our wharves and the cost of producing the same thing in this country, is all the protection that any tariff can yield. All in excess is class legislation in favor of the mighty who do not need it and at the expense of the consumer, and is the parent of those octopuses upon the body politic, called trusts or combines, which are robbing our people of their individuality now, and will continually rob them of their substance and manhood."

F. A. Errington, manufacturer of and dealer in metal-working specialties, 39 and 41 Cortlandt street, New York, says:

"Commercial reciprocity is free trade. Trade should be freer, as is now admitted even by the high protectionists when they pay homage to the principle of free trade by proposing reciprocity. There should be the least possible margin for arbitrary interference with commerce, the great exchange of man-power. Let us have a few fundamental laws to rely upon and not to hide behind. Simplicity is the essential for durability of any law or machine, and any medium that simplifies and renders more accessible the effect of the tariff will tend to bring it down to a better working basis. Publicity is the remedy for our tariff, as for our trusts.

"Appoint a Secretary of Commerce, and let him be the focus for all tariff queries and dissatisfaction, and let it be his duty to throw light on all present tariff laws and their exact effect on any particular article inquired about. Then our manufacturers would know definitely the obstacles to contend with and not see a huge mass through a fog of brokers and interested agents. If a manufacturer could get a concise statement as to just how to pack and mark his goods to secure the lowest possible rate of duty and be informed just what that duty is in dollars and cents, we would soon have an intelligent public opinion brought to bear on tariff questions that would insure just and simple legislation. Get the manufacturer in a position to tell the middleman what to do to sell his goods, instead of the middleman trying to tell the manufacturer of indefinite difficulties that clog the channel through which he must move."

AMERICAN MACHINIST

Published at 218 William St., New York, every Thursday by the

American Machinist Press.

[INCORPORATED.]

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y. Lieber's and A B C Codes.

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Bound volumes for 1901 are now ready and will be supplied at $5 per volume, the purchaser paying express charges. A limited number only can be supplied.

Publishing Humbugs.

Editor American Machinist:

In a recent number of the AMERICAN MACHINIST I saw a little notice of a letter one of your advertisers received from the *Southern Trade Review*, and as I have received several similar letters at different times and have a fresh one on hand I will send it on for you to put with your collection. I think this one is a little the worst I have ever received. I never paid any attention to them except sometimes I have O. K.d them [the articles] and returned them, but have never paid them any money, and I do not think they have ever been published—at least, I have never heard of any that were. I do not know whether this is the same concern under another name or whether there are several publishers in this line of business. However, I will send it on to you and you can do whatever you see fit with it. D. J. C. ARNOLD.

New London, Ohio.

This letter accompanies a letter from and a proposed puff to be published in the *U. S. Trade Reports*, of Cincinnati.

Mr. Arnold is a manufacturer of brick and tile yard supplies and the article he sends is entitled "Perfection Attained in the Manufacture of Brick Molds." It is the usual rot to which no sane or intelligent person would give any attention whatever if it were to be printed and is of course pure humbug. But, after all, the doings of such alleged journals are in a sense simply carrying to its legitimate conclusion a form of puffery which pervades the columns of very many trade papers whose editors and proprietors would be indignant if they were to be put in the humbug class. The fact is that a "puff" or "write up" printed only because an advertiser wants it to appear or because an advertising solicitor thinks he might get a contract if it did appear, is humbug, no matter what paper it appears in nor how respectable that paper may call itself; and what is more, such things are recognized as humbugs by every reader intelligent enough to be of any value to a publisher or to an honest, legitimate advertiser. The paper which indulges in such things lowers its own standing and influence just in proportion to its use of them. The *Southern Review of Commerce*, the *Southern Trade Review* and the *U. S. Trade Reports* have no standing whatever and are recognized as unqualified humbugs because they deal in nothing else but flattery, puffery and "write ups." But is it not strange that so many otherwise sharp, shrewd men, carrying on large manufacturing or business enterprises are continuously deceived by papers calling themselves, and in fact generally classed as respectable and legitimate, but that are always ready to lay anything whatever before their readers that an advertiser asks them to print? The advertiser himself would not waste a moment reading such puffery, nor would he attach any importance to it whatever; yet he seems to think that other men, with sense enough to have acquired dollars that may be invested in what he has to sell will read and be impressed by his own "write up" or puff.

The fact is that "write ups" would be valuable if printed in a paper that never prints them. But printed in a paper that regularly prints them they are worse than useless, whether they appear in a so-called legitimate trade paper or in a sheet devoted solely to such things as are the papers named above, and which of course have no subscribers or readers fit to be outside of imbecile asylums.

We are entirely unable to agree with a statement we find in an editorial article in "The Engineer," of London, which in the course of some remarks on "Production and Trade" says: "Men like Mr. Pierpont Morgan make laws of political economy." Now, it is quite certain that they do no such thing. Their operations may show that what have been announced or assumed to be laws of political economy were not laws at all and were misconceptions. But that men, however powerful or influential, make such laws is certainly not true, any more than that great mechanics or physicists make mechanical or physical laws. Pierpont Morgan is like the rest of humanity amenable to all natural laws and will suffer if he violates them: his operations being so vast that thousands of others are sure to suffer with him for any such violation.

The Osborn Oil Company, of Cleveland, Ohio, has apparently given up for the time being the announcement that it has already shipped oil to various points which is offered at a lower rate, and is now announcing that it is going to ship a carload of oil to various places, and judging from the number of letters we have received from various parts of the country in which it announces that it is going to ship oil to said places its shipments of carloads in the near future will be very large and the railroads leading out of Cleveland are likely to be considerably burdened with these carloads of oil. We hereby give notice, however, that it is likely to be again unfortunate in at least one of these shipments, because it announces that it is going to ship a car of oil to Jersey City, Pa., and as there is no Jersey City in Pennsylvania probably this carload of oil will go astray and may have to be sold at a still further reduction from the regular rates. We would advise the Osborn Oil Company to admonish its mailing clerk who sends out these circular letters to be more careful in his geographical work.

No one who has given the matter any attention doubts the value and advantage of concerted action looking to the improvement of streets and the general features of municipalities. Those who live in man-

ufacturing towns are of course interested in this question and it has its important bearing upon the supply of skilled labor and upon the general living conditions of the workmen and their families. It is something worth noting, therefore, that there is an organization for the purpose of improving the public features of villages and cities, this organization being called the American League for Civic Improvement, whose headquarters are at Springfield, Ohio, and its corresponding secretary, Mr. E. G. Routzahn, of Dayton, Ohio. It is this league which has been the principal mover in the matter of exhibiting a model city at the St. Louis Exposition, and it is hoped that there will also be shown there a model farm, the idea of which has been devised and worked out by a member of the league referred to.

The recent competition at the Grand Palais in the Champs Elysées, Paris, has shown that alcohol can hold its own against petroleum generally, and coal itself in some cases, as an economical source of light, heat and motive power. All kinds of motors, both stationary and portable, were shown working with alcohol in the same manner as they might have been by petroleum, and in the various systems of lighting alcohol affords the same intensity, while for domestic warming and industrial firing it possesses over coal and petroleum the great advantage of being clean, of burning without smoke or smell, and of not fouling the appliances. At the present prices in France, from 50c. to 60c. per litre [37½ to 45½ cents per gallon], debased alcohol, mixed with a carburizer which increases its calorific power, is practically on a par with petroleum; and M. Sabatier asserts in the *Matin* that the price might be reduced to that reigning in Germany, or by more than 50 per cent.

The Safety of The Brooklyn Bridge.

We are in receipt of a pamphlet bearing the above title, which is a reprint of an article by Wilhelm Hildenbrand, C. E., which was published originally in *Engineering News*. Mr. Hildenbrand was Col. Roebling's assistant in the construction of the bridge and as such made the detail calculations for it. The pamphlet is a review of and answer to the report of Messrs. Duryea and Mayer on the condition of the bridge.

This report was a disquieting one and the answer to it is intended to show that its arguments and conclusions are unfounded. The report did not condemn the supervision of the structure in any important respect, as it stated that "no important deterioration exists," but it did condemn the original design by claiming that certain secondary stresses were not provided for in it and in consequence of this the assertion was made that the bridge has never been safe.

Mr. Hildenbrand takes direct issue with these statements and condemns the recommendations made in the report by saying that "to carry out these two alterations would in my opinion be the most fatal error that could be made." The argument is backed up by calculations and the conclusion is that "The Brooklyn Bridge is Safe!"

Mr. Hildenbrand doubtless knows more about the bridge than any other living man and his conclusions will doubtless be accepted by the public, as they should be. It is proper to add that our statements above regarding the conclusions drawn by Messrs. Duryea and Mayer are based upon Mr. Hildenbrand's pamphlet.

Mr. Carnegie's Epitaph.

Editor American Machinist:

There is a statement at page 247 which, if it has not already been pointed out, I take the liberty of drawing your attention to.

In speaking of Mr. Carnegie, you say concerning his epitaph that he said, "Here lies a man who knew how to get around men much cleverer than himself." This is not what Mr. Carnegie said. I sat within a few feet of him and am positive that his expression was, "Here lies a man who knew how to get around him men much cleverer than himself."

There is a vast difference in the two statements, and I think it is a matter of justice to Mr. Carnegie to have you make the correction. W. D. Forbes.

Hoboken, N. J.

The editor of this journal also sat within a few feet of Mr. Carnegie when the words were spoken and feels pretty certain that the words as printed by us were just as they were spoken. We are confirmed in this opinion by the testimony of others and by the corroborative fact that the statement was evidently regarded by Mr. Carnegie as well as by his hearers generally as a joke and was laughed at as such. Now, if it were spoken as we printed it, it was a joke, but with the word "him" interpolated it loses all semblance to a joke and becomes a serious statement, which we are confident Mr. Carnegie did not intend to make regarding his epitaph. The reporter for the *New York Tribune* gave the same version as was given by ourselves. Perhaps only Mr. Carnegie himself can settle the point.

Civil Service Examinations.

The United States Civil Service Commission announces an examination, March 4, 5, 6, for electrical engineer and draftsman in the Supervising Architect's office, Treasury Department, at $1,400 a year. March 25 and 26, an examination in pure mathematics, practical computations and spherical astronomy will be held for assistant piece-work computers in the Naval Observatory and Naval Almanac office; also examinations for chief engineer, Class 3, and watch officer, Coast and Geodetic Survey. For further information and the appropriate application blanks, address without delay either the Commission in Washington or the secretary of local Board of Examiners.

The Chief Examiner of the State Civil Service Commission, Albany, N. Y., announces State and county examinations to be held about March 15 at twenty-four towns for the following positions among others: Assistant steam engineer, $40 to $60 per month and maintenance; associate in chemistry, $1,800 a year; foreman of chair industry, State prisons, $2.50 a day; heating engineer, State architect's office, $2,000 a year; assistant civil engineer, $5.00 a day; leveler, $4.50 a day; rodman, $3.50 a day; chainman, $2.50 to $3.00 a day.

Andrew Carnegie has sent a check for $100,000 to President Henry Morton of Stevens Institute of Technology in Hoboken, as an endowment for the Carnegie Laboratory of Engineering, the dedication of which was described in our last number.

February 10 was the banner pay day in the history of the Pennsylvania Railroad shops at Altoona. Its employees received $530,000 in payment for work done in January. Every department in the shops is taxed to its utmost, getting out new and repair work, and men have been working considerable overtime.

Robert W. Hunt & Co., of Chicago, have been given the inspection of the rails, splice-bars, bolts, nuts and spikes, which the Mexican National Railway Company have purchased in England and Belgium. They have also been given the inspection of rails which the Louisville & Nashville Railroad Company have purchased in Germany. John J. Cone, of the firm, will have immediate personal charge of the inspection of this material and will take with him to Europe a detail of men selected from his firm's American corps of inspectors.

Personal.

The Standard Pneumatic Tool Company, Aurora, Ill., has appointed J. B. Wilson, formerly connected with the mechanical department of the Grand Trunk Railway, manager of the new Canadian offices which they have just opened at 103 Union Station Arcade, Toronto, Ont.

Chas. F. Marquis, who has been for many years in the employment of the Brown & Sharpe Manufacturing Company and who had charge of that company's exhibit at the Pan-American Exposition, has been placed in charge of an office which the company has just opened in the Bourse Building, Philadelphia.

Obituary.

Francis A. Pratt, one of the original partners of the firm of Pratt & Whitney, and for many years president of the Pratt & Whitney Company, died of appoplexy, February 10, seventy-five years old. Some account of his career will be given later.

Commercial Review.

NEW YORK, Monday, February 17.

THE MACHINE TOOL MARKET, ETC.

The winter's demand for machine tools has turned out quite equal to any reasonable anticipations. The remarks of some factors in the business convey an impression that trade is surpassing the standard of last fall. It would probably be putting the case a little too strongly, however, to say that demand is now unprecedented.

To realize in how excellent shape the market now is, one has but to turn back to the reports of a year ago. At that time there was a good deal of doubt how well the works would be able to weather the recent slump in exports and pessimistic rumors were afloat which, although to some extent misleading, reflected a partially demoralized tone in the market. Now everything is serene, with domestic demand enough to give the shops of the country, generally, all the work that they can easily handle, and sometimes more.

The demand for tools by Eastern railroads is hydra-headed. The several large contracts that have been lopped off since the beginning of cold weather are replaced by new out-croppings in the same or other quarters. Last month we reported the placing of large orders by the Baltimore & Ohio. The same road has had specifications out for ninety more tools, on which bids were receivable, nominally, up to the 10th of this month. The Pennsylvania continues an importunate buyer, some of its specifications being out at the present time.

Speaking of placing contracts for machine tools by railroads, some comment has been heard on the wide variation in businesslike qualities shown by the railroads when they go about it. In the case of the Lehigh Valley, it is remarked, the manufacturing end states what it needs and then the purchasing department goes and buys it, just as would be done in a manufacturing establishment. Other prominent railroads could readily be named which, when they have undertaken to buy machinery, have shown an amount of hesitation, vascillation, delegation and sub-delegation which could not be surpassed in lack of self-knowledge by a department store shopper.

Bids on the large proposals for machine tools for the Springfield (Mass.) Armory were opened February 12. Awards, however, are awaited. The monetary amount of the bids is believed to give less indication as to the eventual recipients of the orders than in the case of Navy Department contracts. A bidder, therefore, who had put in the lowest figures on one of the most important lots expressed himself as by no means confident of getting the award. Whether there will be the months of wrangling that followed the Rock Island Arsenal bids a year ago remains to be seen.

Bids will be opened, February 25, for furnishing at the League Island (Pa.) Navy Yard an air compressor, an automatic screw machine and tools.

Some of the most interesting contemporary matters relating to machinery construction center in Philadelphia. William Sellers & Co. are erecting a new brick building about 61x69 feet, five stories, for the exclusive manufacture of the Lanston Monotype Casting Machine. All the machinery required has been contracted for. We have confirmed this much from the firm directly and we understand further that heavy orders have already been booked for the casting machines. It was reported in Philadelphia that the building would be used as a pattern shop, but either it will not be limited to this purpose or a good-sized machine-shop will be put in elsewhere, for a large quantity of Brown & Sharpe milling, screw and grinding machines have been ordered.

The other Philadelphia district item is that the Shepherd Engineering Company, which has been having the W. G. Shepherd vertical engine built by contract for several years, proposes to establish works of its own to employ 300 or 400 men. The Board of Trade of Lancaster, Pa., was recently in negotiation with the company to locate in that town. It was proposed that Lancaster men should take important interests in the new company, the capital of which, it is believed, will be about $200,000. It is said that the Shepherd engines are built up to 600 or 1,000 horsepower and that the United States Government and the Cramps have been among the buyers.

It would be hard to specialize as to the classes of tool most in demand at present, since they vary in different quarters, dependent upon new or improved designs which constitute a drawing card. At one agency there is a great run on milling machines, the average deliveries on which in this case are about four months. In another place grinders are spoken of as in exceptionally good sale.

A prominent local machine tool company reports a perceptible betterment in European trade. The demand evidencing this improved tone does not seem to be centered in any one country, but includes Belgium Germany, etc. Japan is also mentioned in the favorable comment.

The Boston office of a local concern was complaining of being relatively dull some time since, because the cotton machinery manufacturers of that region were reluctant to add to their equipment. This hesitation is attributed to the unfavorable effects of the disturbances in China, a year or so ago, upon the Far Eastern market for cotton goods.

The L. S. Starrett Company's New York store is rushed with business beyond all precedent, and operations are seriously cramped in the present quarters. Arrangements have been made to move across Liberty street, May 1 to No. 123, the corner store formerly occupied by the Pratt & Whitney Company, which affords exceptionally commodious quarters for a line of small tools and a large spread of window.

The stockholders of the E. W. Bliss Company, of Brooklyn, are shortly to pass upon the question of taking over the United States Projectile Company, which is already an allied interest.

J. E. Jones, vice-president and general manager of the Waukesha (Wis.) Sheet Steel Company, was in Pittsburgh last week to place contracts for $200,000 worth of rolling mill and electrical machinery for doubling the works.

The Joseph Dixon Crucible Company, of Jersey City, N. J., which formerly operated four separate steam plants, has now combined them into one electric power plant. A 100-kilowatt generator and twenty-four motors, all of Crocker-Wheeler manufacture, have already been installed and future equipment is contemplated. The Crocker-Wheeler Company reported that the outlook at the end of the first month of the new year was most promising, both in present orders coming in and in the indications for a heavy spring business.

The Curtis & Co. Mfg. Company, of St. Louis, reports that its sales in the line of pneumatic machinery are very steady and that the demand for both compressors and hoists has been very regular for the past three months. Sales for the two weeks ending February 8 consisted of 11 compressors and 106 hoists, as well as a number of their hand cranes and seven of the new ice cranes which they have recently put upon the market.

H. W. Caldwell & Son Company, Chicago, manufacturer of elevating, conveying and power-transmitting machinery, has recently opened a sales and engineering office in New York city at Room 410, 95 Liberty street, through which the company will give personal attention to its Eastern trade. This office is in charge of R. T. Pearce, mechanical engineer.

The Standard Pneumatic Tool Company, Aurora, Ill., has opened new Canadian offices at 103 Union Station Arcade, Toronto, where it will carry a stock for its Canadian customers. The company writes: "Our business in Canada has greatly increased during the past few months, and the outlook is very encouraging."

The Sprague Electric Company has closed an order with the Atlas Portland Cement Company for three 400-kilowatt engine type split pole generators at speed of 156 revolutions per minute for their plant in Hannibal, Mo.; another order is from the De Laval Steam Turbine Company for ten 20-kilowatt and ten 75-kilowatt turbine generators. The Pennsylvania Steel Company have ordered for their new bridge shop at Steelton, Pa., fifteen wall crane trolley hoists, the electric hoisting equipment of which is built by the Sprague Company.

James Clayton, late sole owner and proprietor of the Clayton Air Compressor Works, having sold his entire interests to the International Steam Pump Company, some others, including associates of his, have organized the American Air Compresor works for the manufacture of such machines, etc., as were constructed by the Clayton Air Compressor Works, including air and gas compressors, carbonic acid gas machines, air receivers, vacuum and tar pumps, etc. The plant of the new company is located at Van Brunt and Summit streets, Brooklyn, N. Y., and was formerly the South Brooklyn Steam Engine Works, where John J. Riley, treasurer of the new company, has been employed and established for the last forty years. William S. Fairhurst, late manager of the Clayton works, will have entire charge of manuufacturing. Frederick B. Vail, late manager of the Clayton offices, will have charge of the sales department at the New York offices, 26 Cortlandt street.

CHICAGO MACHINERY MARKET.

"Business during the last six weeks was the best we have ever had; the mail comes in nearly a foot high." Such was the comment of a representative of one of the largest machine-tool houses in Chicago in reference to trade since the new year began. One or two other sellers speak in the same buoyant strain. But the majority of the Western selling agents agencies reported trade fair to good. On the whole, the situation may be described as somewhat more than satisfactory, but not particularly rushing. The trade in machine tools runs largely to small orders. Almost every factor in the trade speaks of a considerable pick-up trade. But large transactions are not so extensively in evidence, though a number are under negotiation. Perhaps the largest closed within the past several weeks was the equipment of a gas-engine plant for Fairbanks, Morse & Co., Beloit, Wis. It is stated that tools to the value of about $30,000 were purchased. Of these Hill, Clarke & Co. are said to have obtained about $18,000 and the balance was scattered. This order first appeared in the market nearly two years ago, but was subsequently withdrawn. The deliveries arranged for are not earlier than May. There have been several other transactions recently to the value of $5,000 or more each and a number will be closed within a few days, if the expectations of sellers are realized. Shapers and radial drills are scarce. Deliveries of Eastern machine tools are slightly better than those of the Cincinnati group of makers. Common report has it that the latter are all running full time and some overtime. Another observation made in reference to the Western machine tool trade is that while Cincinnati is losing none of its tool plants there is not now the notable accessions of new plants in the district that were made several years ago, and that the shores of Lake Michigan seem to be attracting a number of small machine-tool builders, not now especially important to the trade but giving evidences of robust growth.

In the recent specifications for shop equipments it is noted that a larger percentage than formerly are for special tools. There are usually a number of contracts upon which the agent is unable to bid, but which must go direct to the builder. The copper district is an active buyer of tools, a number of shops having recently been provided for mining plants under construction for a year or longer. There is some good railroad inquiry and the Pacific coast is calling for many tools. Quite a little second-hand machinery is coming on the market, the result of renovation of large shops.

The Pearson Machine Company is running full. The demand for screw machines is large and they are said to have not a hand machine in the house.

Quotations.

NEW YORK, Monday, February 17.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$18 15 @ $18 40
No. 2 X	17 65 @ 17 90
No. 2 plain	17 15 @ 17 40
Gray forge	16 65 @ 16 90

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 16 75
No. 2 foundry, or soft	15 75 @ 16 25
No. 3 foundry	15 25 @ 15 75
Foundry forge, or No. 4	14 75 @ 15 25

On Southern irons the minimum we quote is understood to be the price of one prominent furnace company, provided it has iron to sell, while for the general market the maximum we name should be taken as a minimum, with a range at least $1.00 higher.

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.73c. in carload lots. Smaller quantities from store, 1.95 @ 2.00c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—2.00c., with perhaps some still obtainable at 1.95c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½c.

Copper—Lake ingot, 12½c.; electrolytic and casting, 12⅜c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 25¾c.

Pig Lead—4.10 @ 4.12c. in 50-ton lots.

Spelter—About 4¼c. New York delivery.

Antimony—Hallett's, 8 @ 8⅛c.

Lard Oil—Prime City, 77 @ 80c., wholesale.

New Catalogs.

The Keefer Mould Works, Gas City, Ind., have sent us their standard illustrated catalog and price list of molds for glassware. It is 4½x6¾ inches.

The International Acheson Graphite Company, Niagara Falls, N. Y., has sent us a booklet (6½x5½ inches) relating to Acheson graphite electrodes for use in electrolytic and electro-metallurgical processes.

Haberle & Graham, South Bend, Ind., have sent us a catalog of bolt threading and nut tapping machinery. The appliances shown include special rapid screw cutting die heads, revolving turret screw cutting die heads and Becher double and single bolt cutters. The pamphlet is 9x5¾ inches.

We have received three pamphlets, a catalog, prospectus for 1901-1902 and book of views of the Michigan College of Mines, Houghton, Mich. This institution embraces courses in various branches of engineering and science. The first two of the pamphlets referred to are 5½x7½ inches.

Catalog "F" has been received from the Wilmot & Hobbs Manufacturing Company, Bridgeport, Conn. The principal contents is a diversified line of oilers, besides which are shown lamps, steel floor tiling, bicycle tubing, automobile rims, bells, etc. The pamphlet is 6x9 inches, standard size.

Wyman & Gordon, makers of drop forgings, Worcester, Mass., have brought out a little pamphlet entitled "A Short Story of James Watt and the Steam Engine." The frontispiece is from a hammered bronze bas-relief found in a junk shop in New York. A life of Matthew Boulton is to follow. The booklet is 4⅜x6⅞ inches.

Hammacher, Schlemmer & Co., 209 Bowery, New York city, have sent us a cloth-bound catalog (293 pages, 5½x7¾ inches) of builders' hardware, accompanied with price list. The firm send the publication without charge to everybody who will give them assurance that they intend sooner or later to buy from this line.

The Excelsior Needle Company, Torrington, Conn., has brought out an attractive pamphlet (7½x9 inches), divided chiefly into the following chapters: "The Art of Swaging." "The Dayton Swaging Machine," "Some of the Work the Dayton Swaging Machine Can Do," "Catalog Showing Dimensions and Capacities of the Dayton Swaging Machines."

The Eck Dynamo & Motor Works, Belleville, N. J., have sent us a pamphlet describing and listing their direct-current dynamos and motors. These are made for moderate, intermediate and slow speed, of the protected, semi-enclosed and enclosed types, the powers, so far at least as covered by this pamphlet, ranging from ⅛ to 5 horse-power. Size of page, 6x9 inches, standard.

The Western Electric Company, Chicago and New York, has sent us a copy of its new general supply catalog. This volume contains a seemingly unlimited variety of supplies for electric lighting, power and street railway purposes, electrical house goods, etc. It comprises nearly 1,100 5½x7½-inch pages, with 3,000 illustrations. The company sends it bound in dark green cloth, transportation charges paid, for $1.

M. H. Treadwell & Co., 95 Liberty street, New York, have sent us their catalog on "Railroad Car Construction," containing a number of illustrations together with descriptions of various types of wooden freight car construction. The corporation M. H. Treadwell & Co., of Pennsylvania, is successor to the Lebanon Manufacturing Company, Lebanon, Pa. The pamphlet is 9x6 inches, standard size.

Manufacturers.

N. L. Rundio is planning for a new foundry in Williamsport, Pa.

The Rochester (N. Y.) Machine Screw Company's plant has been burned.

The Cuyahoga Stove Repair Company, Cleveland, O., will erect a foundry.

Marcus A. Frost and Frank Watson, Grand Rapids, Mich., will build a new 12,000-bushel elevator.

A new factory will be erected at Milwaukee, Wis., by Joseph Romberger, galvanized iron works.

Schuttler & Hotz, Chicago, Ill., wagon manufacturers, will build a new plant, to cost $200,000.

Work has begun on an addition to the factory of the Perkins Windmill & Axe Company, Mishawaka, Ind.

The foundry of the Gould Coupling Works at Depew, N. Y., has been burned. It will be reconstructed at once.

Ezra Phillips & Sons, tack manufacturers, of South Hanover, Mass., are adding a new building to their works.

The O. Armleder Company, manufacturer of wagons, Cincinnati, O., is looking for a location for a new plant.

Minchener & Henderson have awarded the contract for the erection of an oak spoke factory at Huntsville, Ala.

The Great Northern Paper Company, New York city, is building the foundation for a paper mill at Madison, Me.

Plans have been prepared for a machine shop, 100x100 feet, for the Morden Frog & Crossing Works, Chicago, Ill.

The Mohair Plush Company is to put up a new building at Lowell, Mass., calculated to double the present capacity.

The Luger Furniture Company, Minneapolis, Minn., is having plans prepared for a four-story addition, 75x150 feet.

The factory in Waterville, Que., of George Gale & Sons, manufacturers of mattresses, iron beds, etc., has been burned.

An extension will be built this spring to the mill at Rumford Falls, Me., of the Oxford Paper Company, of Portland.

Tom B. Williams has made arrangements to establish a brick plant at Fairmont, W. Va. About $75,000 will be invested.

The Youngstown (O.) Iron Sheet & Tube Company has acquired 40 more acres of land at Struthers, as room for extensions.

The T. B. Laycock Manufacturing Company, bed spring and mattress maker, Indianapolis, Ind., will build a new factory.

The Wisconsin Manufacturing Company, Jefferson, Wis., manufacturer of furniture, expects to rebuild its burned factory.

It is reported that the Proctor & Gamble Company, Cincinnati, O., will erect a $100,000 cotton seed oil mill in Selma, Ala.

The American Type Founders' Company, 25 William street, New York, proposes to build a big factory in Jersey City, N. J.

The Crossman Edge Tool Company has been formed at West Warren, Mass., and will operate a factory on the Quaboag River.

The factory of John P. Rust, manufacturer of pails, etc., Keene, N. H., has been partly destroyed by fire. The sawmill was saved.

Property at Oneco, Conn., has been sold to Charles H. Case and Charles F. Lincoln, of Mansfield, who propose to erect a paper mill.

The Susquehanna Silk Mills, 57 Greene street, New York (plant at Sunbury, Pa.), are to build a 400x175-foot mill at Marion, O.

Duffy Bros., of Fort Plain, N. Y., have leased a factory in Buffalo and will transform it into a plant for the manufacture of silk.

The American Meter Company will put up in Chicago a building estimated to cost $130,000. It will be equipped with electric transmission.

Rumsey & Co., Ltd., pump manufacturers, of Seneca Falls, N. Y., are considering building additions to their iron foundry and machine shop.

Fred. C. Genge & Co., manufacturers of furniture, St. Anthony Park, St. Paul, Minn., will build a factory which will be fitted with new machinery.

The firm Robb, Hannan & McDonald, founders, machinists and engineers, Pictou, Nova Scotia, has been dissolved and has been succeeded by Robb & Sons.

The Milwaukee (Wis.) Electric Railway & Light Company, it is understood, proposes to build a power-house and car barns on Sycamore and Third streets.

The Wilkes Foundry Company, Toledo, O., it is reported, has secured a site for its foundry at the junction of Woodville street and the Toledo Belt Railroad.

The J. R. Clark Company, manufacturer of boxes and woodenware, Minneapolis, Minn., will erect a new plant with several buildings, one of which will be a power-house.

The offices of the Cincinnati Shoe Heel Company, recently incorporated at Columbus, O., will be established in Cincinnati. The factory will be erected in Batavia, O.

The Utica (N. Y.) Electric Light & Power Company has purchased a building, 48x60 feet, to be used as a station from which to supply power to the trolley company.

The Goulds Manufacturing Company, of Seneca Falls, N. Y., has nearly completed an addition to its machine shop, and will increase the capacity of its pattern building.

Instead of removing the Wood mill from McKeesport, Pa., the American Sheet Steel Company has decided to replace the present plant with a new one, increasing the capacity.

Pickands, Mather & Co., of Cleveland, O., have secured land at Toledo. A steel plant will be erected, to cost $1,000,000 and to have a productive capacity of 400 tons a day.

The E. & G. Brooke Iron Company, Birdsboro, Pa., has let the contract for a new steel foundry. The building will be of brick and iron, 248x220 feet, with an addition 62x140 feet.

The Crane & Breed Manufacturing Company, maker of metallic burial cases, Cincinnati, O., has applied for a permit to construct a new coffin factory at a cost of $30,000.

The crate and basket factory of the Southside Manufacturing Company, on South street, Petersburg, Va., has been burned, with valuable machinery, but will probably be rebuilt at once.

A box and shook factory, which will give employment to at least 150 workmen, will be erected by the Rood Lumber Company, Columbus, O. It will contain nailing, dovetailing and other machinery.

Additions, including a boiler and engine house, will be built at the plant of the Barnes & Erb Company, 3846 Lancaster avenue, Philadelphia, Pa., launderers and manufacturers of laundry machinery.

Poor & Coale, real estate and insurance agents, Baltimore, Md., announce that they have organized a company to erect a large building for manufacturing purposes. Floor space will be rented, with light, heat and power.

The Pennsylvania Rubber Company will, it is reported, erect at Jeannette, Pa., a plant to employ 800 men. The main building will be 300x500 feet, four stories. The other buildings will be grouped around it. The total cost of the plant will be about $400,000.

Henry T. Hale, of the Hale & Kilburn Manufacturing Company, Philadelphia, Pa., furniture and car seats, has purchased a tract of land, 750x200 feet, at Eighteenth street and Lehigh avenue. It is said that several factories will be built on the site.

The Toledo Furnace Company, a new $1,000,000 corporation, has closed negotiations for land at Toledo, O., embracing dock frontage of 220 feet, on which to erect a blast furnace. The company is composed of H. H. McKeehan, Gustave Von Den Steinen, W. B. Stewart, G. W. Catterill and R. H. Crowell, all of Cleveland.

The Pittsburgh Consolidated Coal & Coke Company, recently organized, expects to build a brick plant at New Galilee, Beaver County, Pa., with a capacity of 100,000 brick a day. The company includes C. E. Pool, of the Pool Coal & Coke Company; F. H. Gregg, Samuel Crosby and H. Barlow. The headquarters are in Pittsburgh.

The Sharon Foundry Company has been organized at Sharon, Pa., with capital stock of $250,000. The leading spirits include James P. Whitla, of the Sharon Steel Company; Joseph Biddle and W. W. Shiming, of the Sharon Boiler Works. The company proposes to erect a foundry at South Sharon, and to employ several hundred hands.

The business carried on by Edward G. Watkins under the name "Simplex Time Recorder Company," at Gardner, Mass., has been transferred to a corporation organized under the laws of Massachusetts, which will continue under the same name at the same place. Edw. G. Watkins is president of the new company, and M. A. Creed, secretary and treasurer.

A stock company, of which John T. Dale, of Chicago, is president, and L. Jeff Milbourne, secretary and treasurer, has purchased of Charles Tyler, of Baltimore, and his associates, their interests in the Southern Foundry & Machine Works, Fredericksburg, Va. They will make extensive improvements and also establish other industries at the place.

O. M. Sipel, of Philadelphia, has purchased the business of the Gleason & Bailey Manufacturing Company, Seneca Falls, N. Y. The new firm will continue the manufacture of fire pumps, etc., at the latter place and also build gas engines from ½ to 10 horsepower. Frank C. Beebe, the former superintendent, will have charge of the factory, together with O. M. Sipel and Thomas Sipel.

A million dollar Portland cement plant is to be erected at Rockmart, Ga., by the Southern States Portland Cement Company, the organization of which, in Atlanta, is about completed. It is backed by the Peninsular Portland Cement Company, of Jackson, Mich. The principal offices of the new company are to be located on the eleventh floor of the Empire Building, Atlanta. The president will be W. F. Cowham, at present the general manager of the parent company.

The American Foundry & Machine Company has been incorporated in Delaware with a capital of $200,000 for the purpose of doing a general foundry and machine business. It proposes to turn out castings from 1 pound to 40 tons in gray or white iron and to manufacture mining, manufacturing and special heavy machinery. The plant is under process of erection at Ravenna, O., and the company confidently expects to be in operation by April 15 next. The general offices will be in Ravenna, with a sales office

in Cleveland. The plant will be modern and fully equipped in every particular.

Negotiations have practically been concluded by the officers and owners of the Pittsburgh, McKeesport & Connellsville Railroad for the consolidation of that property with electric lighting plants in the principal towns of the Connellsville region where the road reaches. In this connection the Youghiogheny Light & Power Company is to be formed by Pittsburgh capitalists in conjunction with New York men now being interested. The idea is to operate the traction and lighting properties from a central power plant near the coal mines. The scheme is being promoted by James S. and W. S. Kuhn, of Pittsburgh.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Stamping dies. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

Purchaser for small manufacturing plant : lot, 100x180 feet ; machine shop, 32x68, two story, with line shaft and gasoline power ; foundry, 40x54, new modern equipment ; good location ; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

A thorough machinist, with good shop located in southwestern Ohio, would like to correspond with the object of making permanent contract to build medium-weight machinery ; those having established trade preferred. Address Box 117, AMER. MACHINIST.

I have an established and paying hardware specialty manufacturing business and desire an ambitious and competent partner to take entire care of mechanical end, which is distasteful to me ; investment of a few thousand required ; good chance for growth. Box 187, AMERICAN MACHINIST.

Self-Opening Paper Bags—That's the kind that sell, but the trust controls all patents and machines for making them ; we have a successful machine that does not conflict with the trust and wish to incorporate with reliable party to manufacture the machines and afterwards operate them ; will make sugar bags from 90 lb. paper as readily as from light manilla ; with paper mill on Pacific slope preferred. Address Box 663, Alexandria, Ind.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Draftsman, technical graduate, desires change. Box 182, AMERICAN MACHINIST.

Mechanical draftsman with experience wishes position. Box 141, AMER. MACHINIST.

Practical and systematic shop foreman, hustler and up to date, desires position. Box 184, AMERICAN MACHINIST.

In New England, mechanical draftsman and designer, competent to manage drawing room. Box 175, AMERICAN MACHINIST.

Machine designer, draftsman ; age 30 ; gas engines, laundry machinery and machine tools ; references. Box 186, AMER. MACH.

Competent draftsman on air and gas compressors, steam and gas engines is open for engagement. Box 160, AMERICAN MACHINIST.

Machine shop foreman, experienced, thoroughly practical and reliable ; first-class references. Address P. O. Box 239, Quincy, Ill.

Patternmaker of 27 years' experience wishes to correspond with reliable concern wanting foreman ; A1 references ; age 45. Box 153, AMERICAN MACHINIST.

Bright, ambitious young draftsman desires position where there are good chances for advancement on merit ; A1 references. "Worker," care AMERICAN MACHINIST.

Toolroom foreman open for position as foreman or assistant in up-to-date shop ; accustomed to designing special tools, dies and fixtures. Box 176, AMERICAN MACHINIST.

An erecting engineer, 25 years' experience with general machinery, desires position as master mechanic of mill or factory ; best references given. Box 172, AMER. MACH.

Mechanical engineer, experienced in organization of new equipment, 10 years' in shop and office, technical graduate, desires change. Address Box 185, AMER. MACH.

Mechanical engineer with extensive experience at designing and constructing metal working machinery and tools, wants to make a change. Box 183, AMERICAN MACHINIST.

A practical, experienced superintendent or general foreman desires to change his position ; expert in jig and tool system ; engine work preferred. Box 157, AMER. MACHINIST.

Mechanical draftsman, German, 11 years' experience in shop and office ; 4 months in America ; speaks some English ; moderate salary at start. Box 170, AMERICAN MACHINIST.

An engineer (civil and mechanical) and draftsman wishes responsible position ; 9 years' experience ; best references ; heavy machinery or mill work preferred. Box 150, AMERICAN MACHINIST.

Experienced manager of works and production of small high-class electric and other fine brass work, also injector and other jet apparatus, is open for engagement. Box 173, AMERICAN MACHINIST.

Situation as foreman by a first-class blacksmith of wide experience on light and heavy work ; good executive ability ; capable of designing tools for economical production of work. Box 174, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, desires responsible position with progressive concern ; 4 years' experience, shop, power, plants, conveying and elevating machinery. Address Box 122, AMERICAN MACHINIST.

Mechanical engineer, experienced designer of automatic machinery and tools, thoroughly competent to take charge of design and construction, graduate, with references, wants responsible position. Box 148, AM. MACH.

A practical superintendent of 15 years' experience in charge of large machine works, expert in shop system, piece work, tools, jigs and manufacture of electrical machinery, desires engagement. Box 169, AMER. MACH.

A designing engineer, well up in Corliss engines, pumping machinery and power transmission, practical, inventive, accurate, wide experience as constructor and erector, familiar with shop practice, is open for engagement. Box 154, AMERICAN MACHINIST.

Married man, 27, machinist and toolmaker, experienced foreman, executive ability, all-around hand, wants hard work and high wages ; graduate school of experience ; Northern shop preferred ; references. Address "Dripps," care AMERICAN MACHINIST.

Bookkeeper, aged 30, single ; thoroughly experienced in manufacturing line ; up to date methods ; all-round man ; capable of taking charge of office ; exceptional references ; salary required $20 per week ; vicinity of New York preferred. Box 181, AMER. MACH.

Manager or superintendent of works ; a practical mechanical engineer desires change ; experienced in estimating and designing hoisting, conveying machinery ; capable of handling machine, foundry and blacksmith shops to reduce cost of manufacture. Box 151, A. M.

Wanted—Position as superintendent of machine shop or manufacturing plant, by a young man of successful experience in the manufacture of interchangeable parts and building special and complicated machinery ; an expert as to tools and methods of systematic production ; energetic, resourceful and a good manager of men ; open for engagement March 15. Address A. I. M., care AMERICAN MACHINIST.

Help Wanted.

Wanted—Technical graduates for engineering work. Address N. Y. Z., care AM. M.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Wanted—Two experienced patternmakers for Colorado ; wages 30 cents per hour. Address Box 105, AMERICAN MACHINIST.

Three machine tool foremen, two erection foremen and two inspectors used to heavy machine work. Box 115, AMER. MACHINIST.

Wanted—Two experienced mechanical draftsmen on electrical machinery ; thorough and practical men wanted. D., care AM. M.

Wanted—Young man to make tracings and detail work ; write, giving full particulars as to age and experience. Box 144, AM. MACH.

Wanted—First-class draftsman on engine work in Providence, R. I. ; state experience and wages expected. Box 165, AMER. MACH.

Wanted—Young man with some knowledge as draftsman, to work on drawings and about machinery in general. Box 178, AMER. MACH.

Wanted—First-class draftsman on engine work ; give references, experience and salary expected. The Ball & Wood Co., Elizabeth, N. J.

Wanted—Brass foundry foreman, experienced on valve work, brass fittings ; state age, experience and salary expected. Box 143, AMERICAN MACHINIST.

Wanted—Experienced draftsman, preferably familiar with hydraulic pump work ; state age, experience and reference. Box 167, AMERICAN MACHINIST.

Wanted—Draftsmen for tool and general work, by large electrical manufacturing company. Address, with full particulars, Box 163, AMERICAN MACHINIST.

Wanted—Number of patternmakers, experienced on compressor or steam engine work ; none others need apply. Franklin Air-Compressor Co., Franklin, Pa.

Wanted—Five experienced machinists for Colorado, to run tools, boring mill, planer and lathes ; wages 30 cents per hour. Address Box 106, AMERICAN MACHINIST.

Wanted—Machinists accustomed to accurate work ; good wages and steady employment to the right men. Leland & Faulconer Manufacturing Company, Detroit, Mich.

Wanted—Some electrical and mechanical draftsmen for switchboard and general drafting work. Apply Engineer of Drafting Dept., General Electric Co., Schenectady, N. Y.

Wanted—First-class toolmakers, experienced on valve tools and fittings, capable of taking charge ; state age, experience and wages expected. Box 142, AMERICAN MACHINIST.

Wanted—A good detail draftsman with experience in machine tool work ; must be quick and accurate ; state age, experience and salary. Address Box 145, AMER. MACHINIST.

Wanted—Several tool and die makers on small work ; factory in Worcester County, Mass ; state age, experience and wages expected. Box 168, AMERICAN MACHINIST.

Wanted—A first-class toolmaker, experienced in making cutters for gears preferred ; also one gear cutting man for office and shop. Address Boston Gear Works, Boston, Mass.

Wanted—Foundry foreman for modern shop in Central New York employing about ninety iron and ten brass molders ; state age, experience, wages and references. Box 159, AM. M.

Wanted—An up-to-date lathe foreman for department employing 20 men on details for planers, boring mills and radial drills. Apply The American Tool Works Co., Cincinnati, O.

Mechanics, engineers, electricians, firemen, etc. A free scholarship in engineering will be awarded to a few well-recommended applicants. American School of Correspondence, Boston, Mass.

Wanted—Competent cost clerk, experienced in steam engine manufacture ; must be first-class man ; write, giving experience, age, references and salary expected. Box 188, AMERICAN MACHINIST.

Wanted—Draftsman, mechanical designing, with experience on automatic machinery ; good position for thoroughly first-class man ; state experience and qualifications in full. Address Box 180, AMERICAN MACHINIST.

Wanted—Capable superintendent for shop in central Massachusetts employing 50 hands in the manufacture of high-grade machine tools. Address, stating age, experience and salary expected. Box 164, AMER. MACH.

Wanted—Thoroughly posted marine and stationary gas engine man, capable of designing a complete and high grade line of engines

and also acting as superintendent of shop; technical graduate preferred. Box 162, A. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Shop agents everywhere to introduce a line of high-class machinists' tools, indispensable to every mechanic; an easy way for the right person to make money; full particulars on application. Massachusetts Tool Co., Greenfield, Mass.

Wanted—A few good machinists to assist in building and adjusting automobiles and gas engines; good positions await men who will each make use of two or three inexperienced men. Address Thomas B. Jeffery & Co., Automobile Works, Kenosha, Wis.

Wanted—A working patternmaker foreman, to take charge of small pattern shop connected with concern located in Western Pennsylvania, building machine tools; give age, experience, salary expected and reference. Box 147, AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman for brass foundry, experienced in making brass valves and fittings, familiar with molding machinery and mixing of metals; state age, experience, salary expected and references. Box 104, AMERICAN MACHINIST.

Wanted—Foreman and layer-out in a contract boiler shop employing 25 men; capable of laying out all kinds of boiler and tank work and experienced in handling men; give age, experience and wages wanted. Address "Cincinnati Boiler Maker," care AM. MACH.

Draftsman wanted; young man capable of drawing and designing light machinery, under instruction, and with some knowledge of tool designing and shop practice; give age, experience, salary expected and full particulars in answering. Address Box 166, AM. M.

Salesman Wanted—To travel in Atlantic Coast States; must be a thorough mechanic of good address; one well acquainted with the Gisholt turret lathe preferred. Apply only by hand-written letter, giving experience and references, to Walter H. Foster, 126 Liberty street, New York.

Wanted—Reliable, sober and competent foreman for machine shop department; thorough mechanic; one who understands up-to-date methods of producing work economically and handling men; state experience, give references and salary. Great Western Mfg. Co., Leavenworth, Kansas.

Wanted—By large firm in Middle West, mechanical draftsmen and first-class toolmaker, experienced in making punches, dies, jigs and all special work in connection with the manufacture of electrical machinery, also in handling men; none but thoroughly competent, experienced man need apply. Box 177, AM. M.

Wanted—Engineering draftsman, thoroughly competent to make drawings of electrical and other machinery; none other than an expert engineer, willing to work on a drawing board, will be considered; wages $40 per week; preference will be given to a technical graduate. Address Box 146, AM. MACH.

We are equipping a mechanical laboratory for the development of telephone work and invite expert mechanics to communicate with us; only expert workmen on small work wanted; those having experience with telephone construction preferred; state full experience, references, wages expected; reply only by letter. Address Engineer, Submarine Signal Co., Pope Building, Boston.

Wanted—Two good planer hands; must be non-union; very pleasant shop in Ohio; have never had any labor trouble of any kind; wages, 7-foot planer 35c. per hour, 5-foot planer 30c. per hour; nine hours per day; can also use a good shaper and lathe hand; wages to these according to ability; do not apply unless you are competent, steady, sober and non-union and want a permanent job. Address "Planer," Box 151, AMER. MACH.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
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Gay & Ward, Athol, Mass.
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Bickford Drill & Tool Co., Cincinnati, O.
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Niles Tool Works, New York.
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Wyman & Gordon, Worcester, Mass.

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Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

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Am. Gas Furnace Co., N. Y. City.

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Niles Tool Works, New York.

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Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

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Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
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Goodell Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Universal Mach. Co., Provi., R. I.
Washburn Shops, Worcester, Mass.
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Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

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Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mch. Co., Pittsburg, Pa.

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Schacht Mfg. Co., Cincinnati, O

Heads, Exhaust
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C & C Electric Co., New York.
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Hoists, Hand
Harrington, Son & Co., Edwin Philadelphia, Pa.
Yale & Towne Mfg. Co., New York

Hoists, Pneumatic
Cleveland Pneumatic Tool Co. Cleveland, O.
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Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Whiting Fdry. Equipment Co., Harvey, Ill.

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Brown Hoisting Mchry. Co., New York.
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Eastern Machry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
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Instruments, Drawing
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Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

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Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
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Gray & Prior Mach. Co., Hartford, Conn.

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Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

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Whitney Mfg. Co., Hartford, Ct.

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General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y.
Lea Elec. Mfg. Co., Anderson, Ind.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Schwickart, Ph., Brooklyn, N. Y.

Lathe Feed
Nat'l. Mach. Tool Co., Cincin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Washburn Shops, Worcester, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Universal Mach. Co., Providence, R. I.
Watson Mach. Co., Paterson, N. J.

Machinists' Small Tools
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Wells Bros. Co., Greenfield, Mass.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Universal
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works, New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mch. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Conn.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Soft Hammer
Field, Chas. H., Providence, R. I.

Molds, Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans and Tote Boxes
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Anderson & Co., E. W., Washington, D. C.
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Copp & Co., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Frothingham, N. L., New York.
Patent Title & Guarantee Co., New York.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe and Fittings
Crane Co., Chicago, Ill.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works, New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.

Profilers
Garvin Mach. Co., New York.

Pulleys
Howard Iron Wrks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Van Dorn & Dutton Co., Cleve., O.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Wks., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Recorders, Speed
Starrett Co., L. S., Athol, Mass.

Rheostats
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
Ball Bearing Co., Boston, Mass.
Roller Bearing & Equip. Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach Co., Windsor, Vt.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Windsor Mach Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Bowler & Co., Geo. H., Cleveland, Ohio.
Davis Iron Works, F. M., Denver, Colo.
Dawson, John H., Chicago, Ill.
Doan & Co., J. B., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Machinery Exchange, Chicago, Ill.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
Amer. Tool & Mch. Co., Boston, Mass.
Springfield Separator Co., Springfield, Vt.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works, New York.
Potter & Johnston Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburgh Shear Knife & Mch. Co., Pittsburgh, Pa.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works, New York.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Machinery
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., N. Y. City.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Crane Co., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Hart Mfg. Co., The, Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Trucks, Shop
Towsley Mfg. Co., J. T., Cin., O.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York

Turret Machines
Amer. Tool & Mch. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works, New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Valves
See Steam Fittings.

Vises, Metal Workers'
Howard Iron Wrks., Buffalo, N. Y.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Gearing
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

An Automatic Recording Machine.

BY E. C. OLIVER.

In conducting tests of steam, gas or other engines or machines it is the usual custom to employ a number of observers who, at stated intervals or at a predetermined signal, take simultaneous readings of various instruments, the interval between these readings being from one to fifteen minutes, varying with the nature of the test. The data obtained in this manner are afterward averaged or otherwise "worked up" and the results are accepted as indicative of the average performance of the engine throughout the test.

If the conditions are fairly uniform during the tests or if the changes are gradual, extending over several readings, this method may give results sufficiently accurate for any practical purpose; if, however, the changes are frequent and considerable in amount, the simultaneous readings may or may not represent the average conditions since the previous observation and a factor of uncertainty is introduced in the results. The question of the accuracy or reliability of such tests has been the subject of a number of discussions from time to time in the technical journals.

The machine described in this article was designed by the writer for the purpose of overcoming these uncertainties by recording on a continuous strip of paper the momentary changes of conditions throughout the test, thus producing in the end a sort of graphical log to be used as a basis of calculation for the final results.

The half-tone illustrations, Figs. 1, 2 and 3, show front, rear and overhead views of the machine, and Figs. 4 and 5 show some of its details. It consists essentially of two parts: the paper feeding mechanism and the recording mechanism. A supply of paper is carried on a roll supported by shaft *A*, Fig. 4. The sheet is led upward over a horizontal brass plate to a pair of rolls *E* and *F*, over which it passes in an S shape, to give the necessary friction for feeding. From these rolls it passes to a receiving roll on shaft *H*. The paper is fed forward by the motion of the engine or machine under test, connection being made between the engine shaft and driving shaft *B* of the machine by a light steel rod. The driving shaft *B* extends to the opposite side of the machine, where its motion is reduced through a worm and gear in a ratio of 100 to 1. A pinion *D* on the shaft with this worm gear but on the front of the machine engages a gear on the feed roll *E*. [The worm shaft is vertical in Fig. 4 but horizontal in Fig. 1.] The paper therefore travels forward with a speed proportional to the speed of the driving shaft. This speed may be varied as necessary by using gears of different ratios between *D* and *E*.

The two feed rolls are driven together by gears *E* and *F* and the receiving roll *H* is driven from gear *F* through an idler *G*. A friction device between the gear on *H* and its shaft, shown in detail in Fig. 5, accommodates the speed of rotation to the increasing diameter of the roll. The tension on the paper in front of the rolls is adjusted by means of this friction device, and the tension behind the rolls is adjusted by means of a band brake on shaft *A*. A positive acting clutch interposed between two sections of the shaft *B* allows the feeding mechanism to be started and stopped at will.

The record is made as the strip of paper passes under a number of pens on top of the machine, the general arrangement being shown in Fig. 3. There are twelve of these pens available for taking eight readings. The pens shown on the rear bar are for tracing the base lines for the mov-

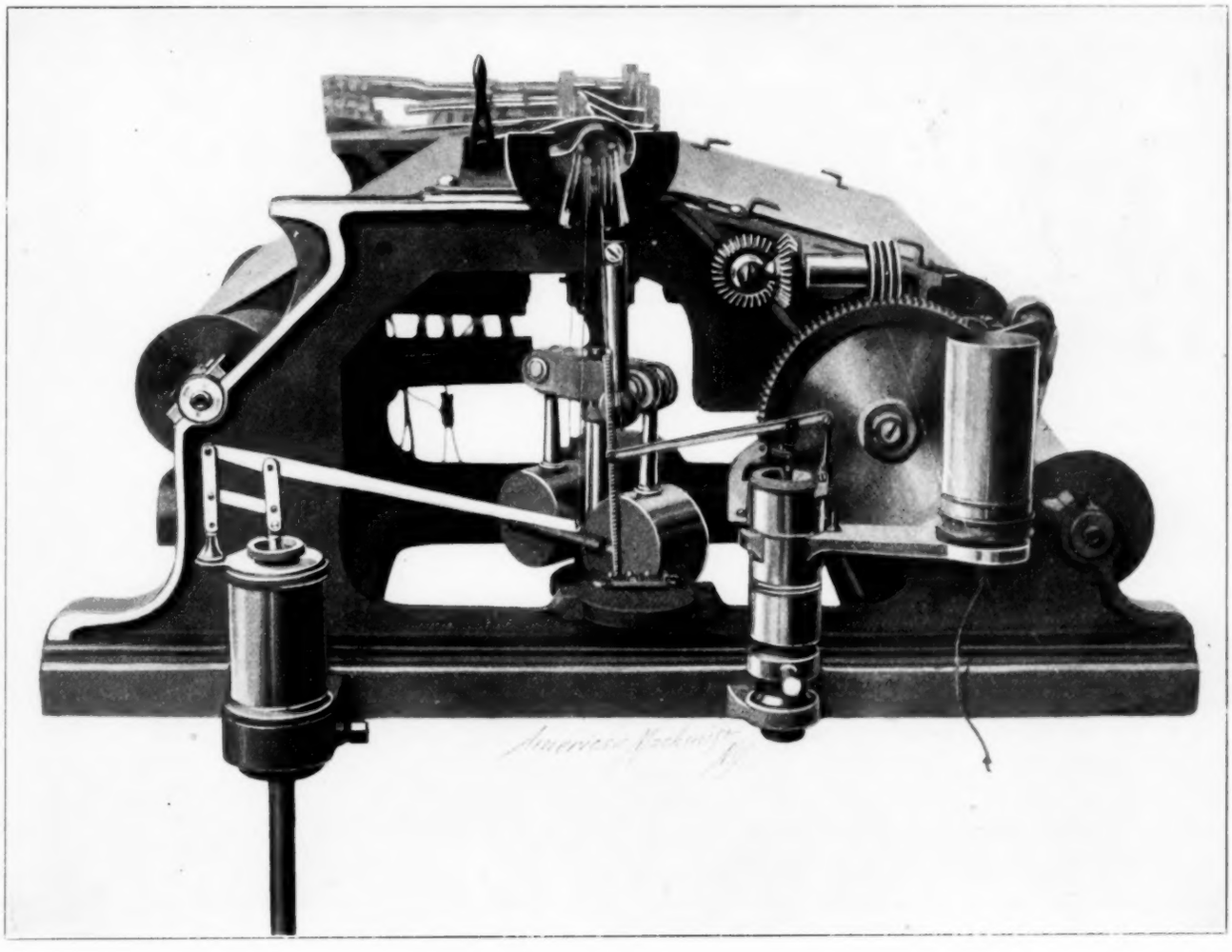

FIG. 1. FRONT VIEW OF RECORDING MACHINE.

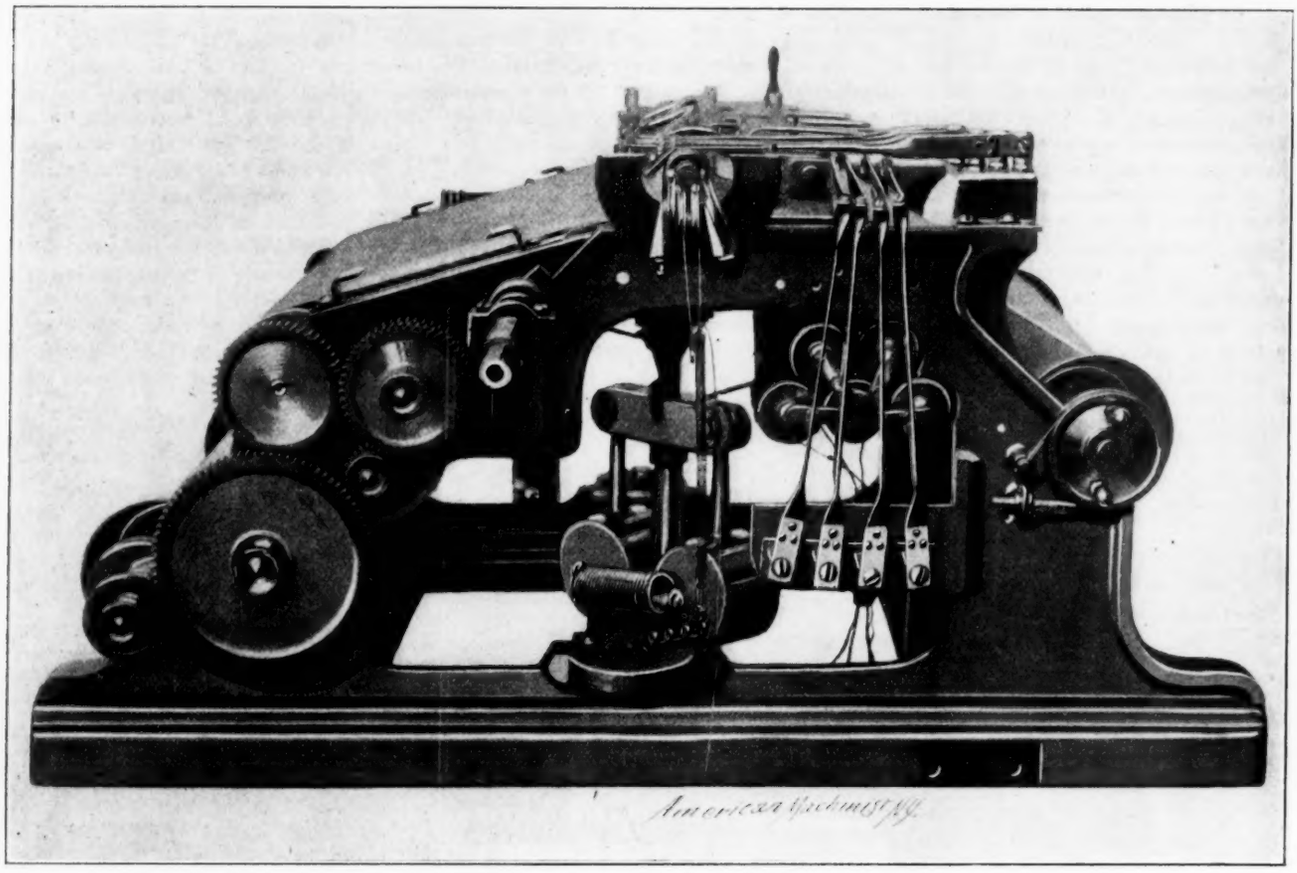

FIG. 2. REAR VIEW OF RECORDING MACHINE.

able pens in front. The four pens to the right are connected through a system of levers to the armatures of electromagnets, so that the closing of a circuit by any means will cause one of these pens to shift, thus indicating by a jog in the line some movement a record of which is desired. The pens at the left are held in runners which slide on a circular bar. They are actuated by light cords attached to the under side and led over pulleys on either side of the machine to a moving part of the engine or instrument the extent of whose movement it is desired to record.

The pens are shown in detail in Fig. 5. The pen proper is in the form of a small tube and bears against the paper at an angle. The supply of ink is carried in a well just behind the pen, the flow being obtained by means of very small wicks which extend from the bottom of the well to a point near the tracing end of the pen.

In the electrically operated pens the joints between the several levers are made by inserting strips of very thin spring steel, thereby obviating much of the lost motion and friction of pin joints. The pens may all be raised from the paper simultaneously by the action of a lever at the side of the machine.

The method of connecting the machine for taking a record from a gasoline engine is indicated in Fig. 6 and a portion of the record of this test is shown in Fig. 7. The upper line is made by connecting

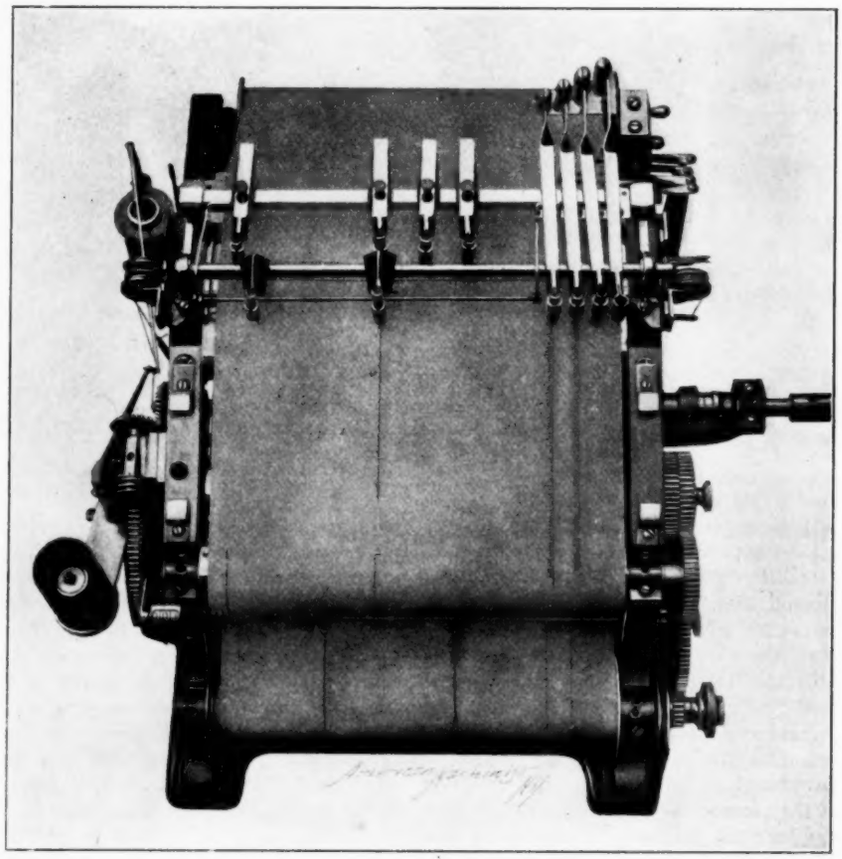

FIG. 3. TOP VIEW OF RECORDING MACHINE.

the terminals of one electromagnet to a clock which makes contact at stated intervals, fifteen seconds in this case. The second line is made by attaching a brass contact piece to the engine in such a manner that the lever which injects the gasoline charge will strike it at each injection, thus making contact and causing the pen connected with it to make a jog and indicate an explosion. The third line represents revolutions, contact being made at each revolution of the side shaft, each mark representing one cycle or two revolutions of the engine. To make the fourth line, a push-button is attached to the indicator in such a way that when the pencil is pressed to the paper, electric contact is made and the recording pen is pushed out, in which position it remains so long as the indicator pencil is in contact with the paper. The effect is shown at *A*, the diagram covering six explosions.

The speed curve is obtained by connecting one end of a cord to an arm actuated by a centrifugal governor mechanism shown in Figs. 1 and 2. This cord extends upward over a light pulley across the machine over a similarly placed pulley and downward. A light spring connected to this end of the cord effects its return motion when drawn in the opposite direction through the action of the speed mechanism. Near the middle of this cord is attached the runner carrying the speed pen. Any movement of the governor below, due to a change of speed, will instantly show a corresponding movement of the pen above.

The method of obtaining the line representing horse-powers may be seen by reference to Fig. 6. The brake arm is shown resting directly on the piston of an hydraulic cylinder, the area of which is one-half of a square inch. A small pipe connects this cylinder with the cylinder of a steam-engine indicator attached to the side of the recording machine. The system being filled with oil by means of the pump shown in Fig. 6, any pressure imposed by the brake will be transmitted to the under side of the indicator piston, raising it against the resistance of the usual spring. The upward movement of the arm is thus a measure of the pressure at the end of the brake arm and consequently of the horse-power. This movement is transmitted to the pen above by means of a cord in the same manner that the speed is indicated.

At the point marked *B* the load was considerably increased by tightening the brake. The effect on the speed and number of explosions is apparent.

Fig. 8 shows a portion of a record taken from a Corliss engine in the power plant of the Champaign Electric Light and Power Company. The engine furnishes power for a street railway. The first five lines were made by methods similar to those used in the gasoline-engine test. The steam pressure was obtained by connecting the steam pipe just above the throttle

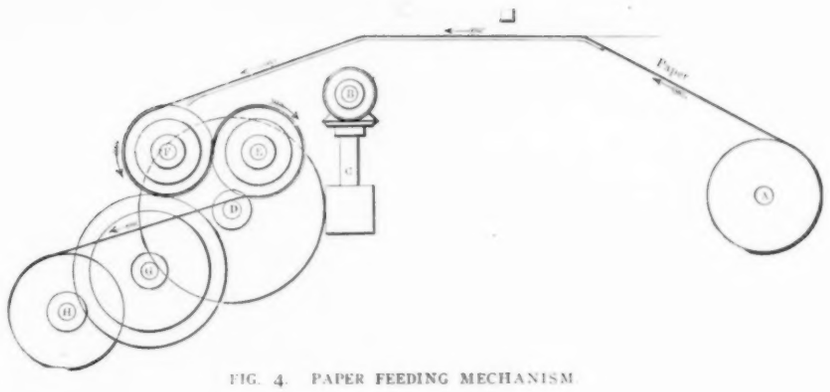

FIG. 4. PAPER FEEDING MECHANISM.

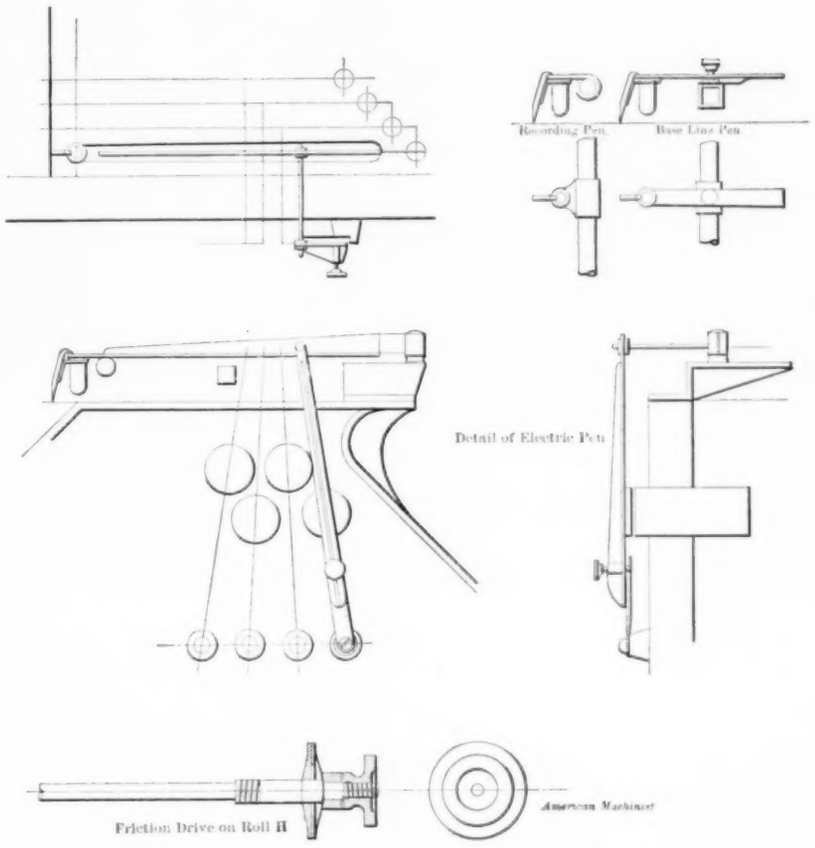

FIG. 5. DETAILS OF MECHANISM.

with the indicator used in the previous test for recording horse-power. The line representing horse-power was obtained through the motion of the engine governor by connecting a cord to a vertically moving arm. This cord was led by means of pulleys to a pen on the machine in a manner similar to that already explained. Thus any movement of the governor up or down was instantly shown in its true amount by a movement of the recording pen on the paper.

This line then really gives a record of governor positions; yet, as cut-off is directly affected by the position of the governor and as the mean effective pressure is dependent on the cut-off, provided the steam pressure is constant, the same position of the governor will at any time give practically the same mean effective pressure. The curve is calibrated by taking a number of indicator diagrams from the engine throughout the test, the time of taking and the governor position in each case being automatically recorded. In this way the horse-power may be computed for the various governor positions and a scale made which, when moved along the line, will indicate the horse-power for each revolution, if necessary. While subject to some slight error, this method greatly assists in studying the performance of such engines.

Fig. 9 is a portion of a record of a pulling test on the Big Four Railroad made with the dynamometer car of the University of Illinois. In this record the upper line, as before, records the time, the

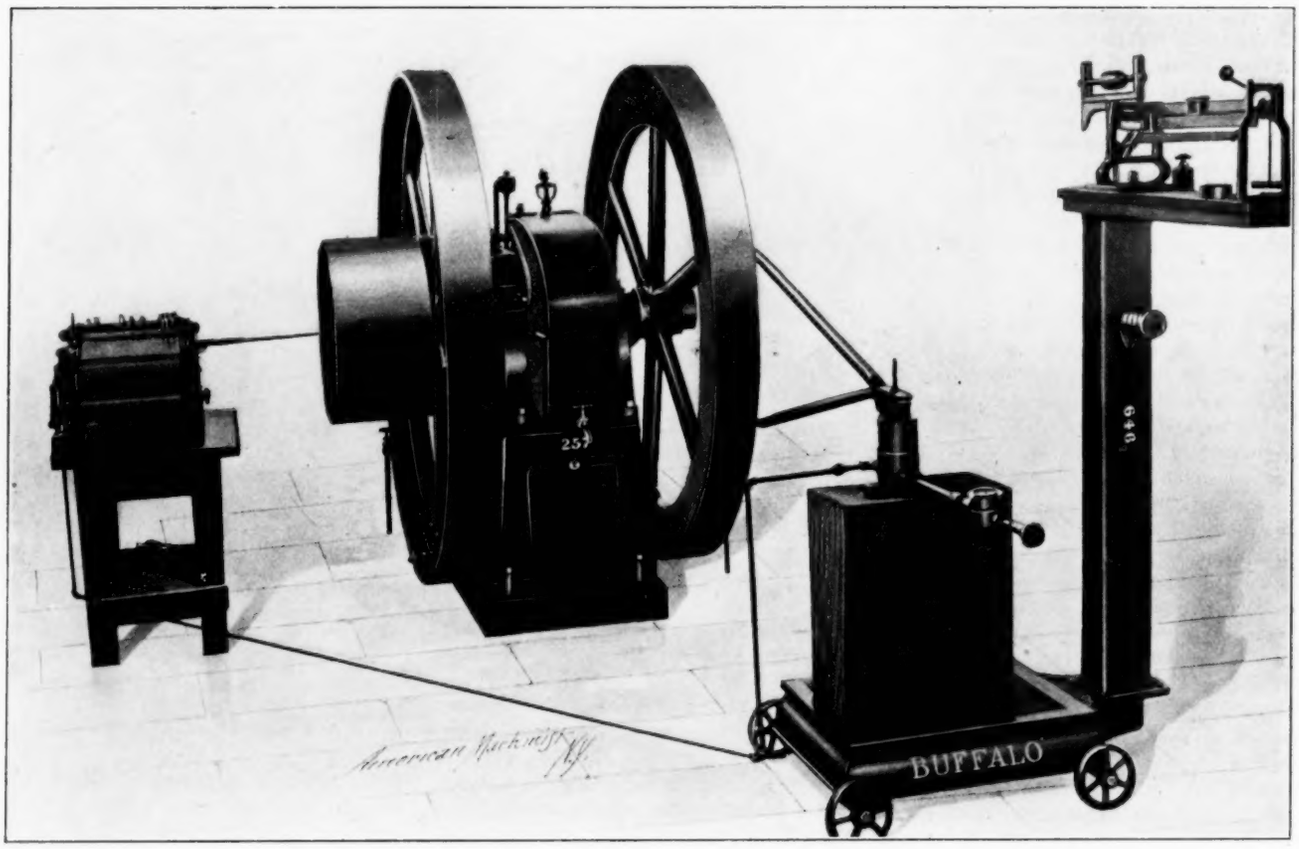

FIG. 6. INSTRUMENT APPLIED TO A GASOLINE ENGINE TEST.

second mile posts, recorded by an observer with a push-button. The third line is for recording various characteristic features of the road, such as top and bottom of grades, stations, etc., to facilitate working up results.

The fourth line shows the speed, the motion being given to the pen by a Boyer speed recorder. The fifth record, the draw-bar pull, is obtained by connecting the indicator on the recording machine with the pressure side of the hydraulic cylinder against which the locomotive pulls. The sixth record, which indicates curves, was made by means of a specially constructed mercury level placed across the car.

The records are in this manner all traced to the same scale of time or distance and all collected on a single sheet, thus greatly facilitating the process of working up and at the same time greatly decreasing the possibility of error due to incorrectly marking the several individual records.

The records shown have many interesting details which a slight observation will disclose. Numerous other experiments or operations may be suggested in which a machine of this sort can be utilized for the purpose of obtaining useful information.—University of Illinois.

Prof. Rowe, of the Colorado State University, recently thawed out 80 feet of frozen water pipe in 25 minutes by passing through the pipe an electric current of 160 amperes, voltage not stated.

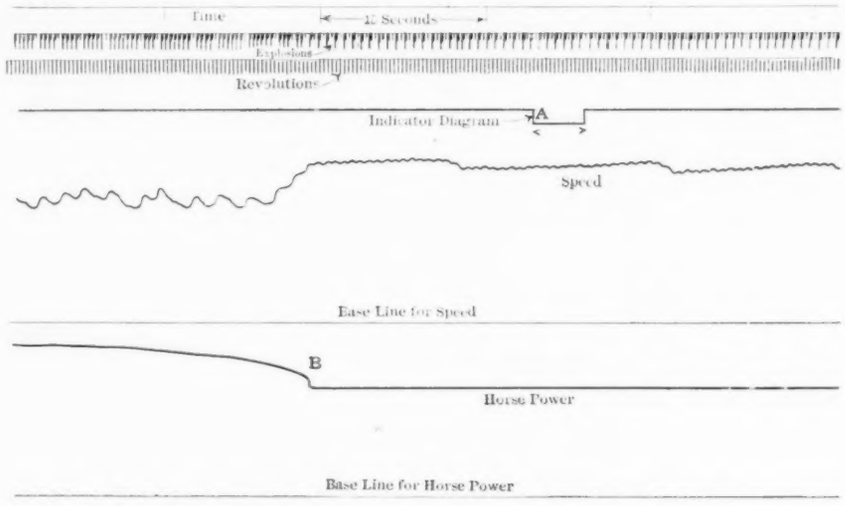

FIG. 7. RECORD FROM A TEST OF AN OTTO GASOLINE ENGINE.

The Economics of the Premium Plan—Objections Considered and Answered.*

BY F. A. HALSEY.

The first question to be decided after the adoption of the plan has been determined upon is the rate of the premium—that is, what proportion of the value of the time saved is to be given to the workman who saved it.

*Extracts from a lecture before the mechanical engineering students of Cornell University. The first part of the lecture was a restatement of the system, with comparisons between it and the day's work and piecework plans. As readers of the AMERICAN MACHINIST are already familiar with this aspect of the subject it is omitted from these extracts.

For this there is a perfectly clear principle to guide us and that principle is precisely the one which we use in buying anything whatever with money, viz., to pay what is necessary to get what is wanted but to pay no more. If we have a fence to paint or a roof to shingle, the only principle we ever think of following in order to get the work done is to pay enough to induce someone to do it. If we offer less than that, the work will go undone, while if we pay more the surplus is a simple gratuity. So here. A workman has been working at the usual pace and has been paid the usual daily wages.

If we wish to induce him to do more, we should offer enough as a premium to induce him to make the extra exertion, and no more. If we offer too little he will reject the offer, the offered returns being too small to recompense him for the effort and the desired increase will not be obtained. On the other hand, if we offer too much, the surplus, as in the case of painting the fence or shingling the roof, is a simple gratuity.

Looked at from this standpoint it is clear that there can be no single rate of payment which will apply to all classes of work. In the machine shop, for example, increased output is largely a matter of intelligence. The workman uses coarser feeds, higher speeds and deeper cuts. He has several tools at hand and grinds one while another is at work, so that, as soon as one is dull, another may be slipped into its place without loss of time. In other words, he crowds the machine rather than himself. In the blacksmith shop or foundry, however, increased output can be secured only by actual increased muscular effort by the workman. It is clear that in the first instance a smaller premium will suffice than in the others.

I have always considered this feature of the plan, whereby the incentive can be graded according as the work is laborious or not, to be one of its best features, though it has attracted less attention than it deserves.

Looking at the premiums when settled in accordance with this simple principle of paying what is necessary but no more,

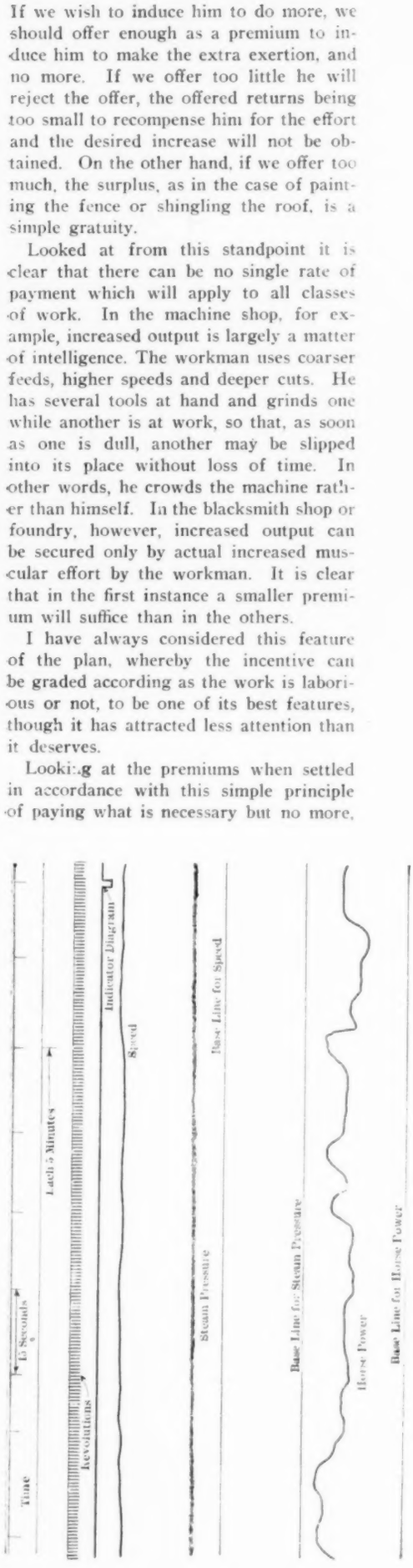

FIG. 8. RECORD FROM A TEST OF A CORLISS STEAM ENGINE.

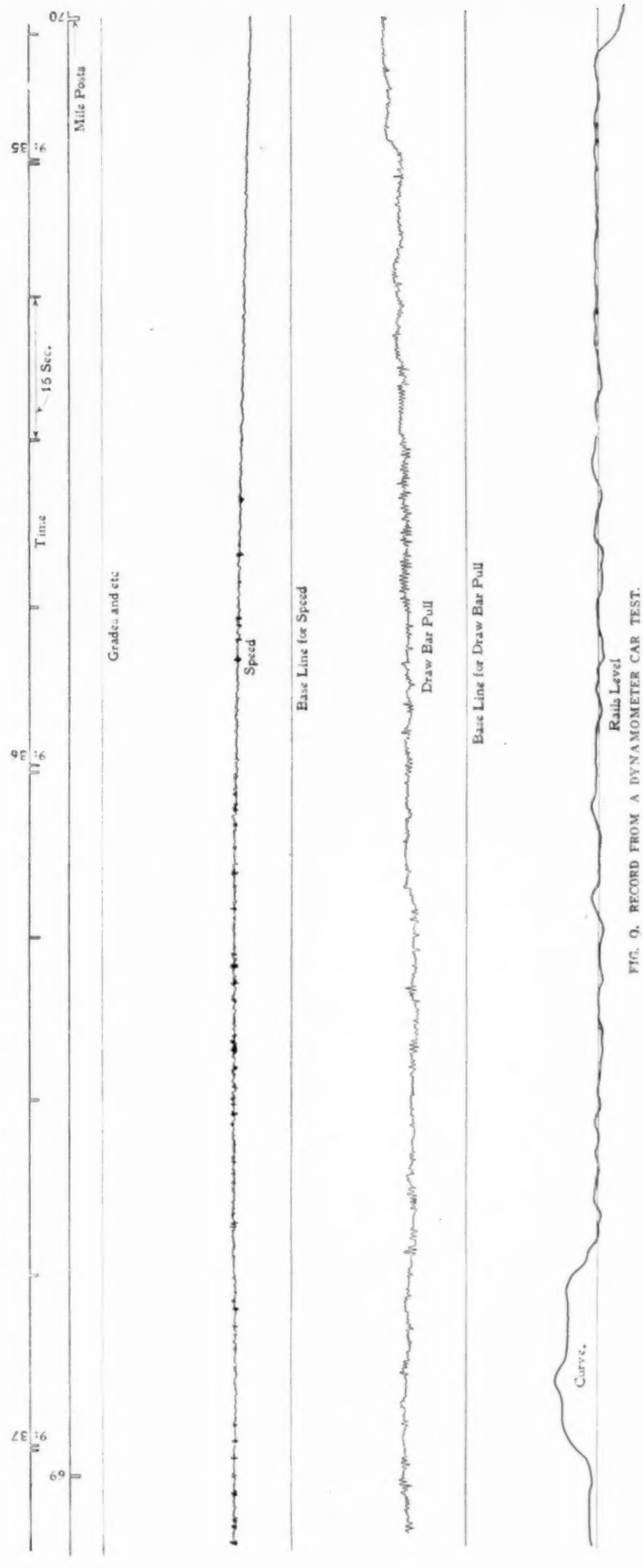

FIG. 9. RECORD FROM A DYNAMOMETER CAR TEST.

we learn several things, of which the first is that they are in no sense bonuses or gratuities, but that, on the contrary, they are, in the fullest sense of the word, earnings.

As well call the increased earnings of the American over the European workman gratuities as to call these premiums by that name. We are all glad to believe that the American workman is more efficient and that he earns more money than the European workman, though the fact is explained in different ways. The free trader explains it by saying that the American gets more because he does more, while the protectionist simply reverses cause and effect and says that he does more because he gets more. Both agree, however, that the increased output and the increased earnings go together and that the one justifies the other, as indeed is self-evident. The premium plan simply carries the process a step further and proposes a permanent increase in the efficiency of labor, and if efficient labor is worth more than inefficient labor, then the premiums paid for and to secure increased efficiency are absolute earnings and in no possible sense gratuities.

In this connection it should be said that the name premium plan is not and never has been entirely satisfactory, because the term premium carries with it the idea of a bonus or gratuity. I searched the English language through for a better term, and for a time I had a leaning toward the term dividend plan, because the word dividend implies a division of something that has been earned. The word is, however, identified with a division of profits, and to have used it here would have involved confusion with the profit-sharing plan. The word premium was therefore adopted, not because it was satisfactory, but because it was less unsatisfactory than any other available word.

Looking at the premiums when settled in this way, we learn, secondly, that they do not need to be cut from time to time, but that, so long as the methods of production do not change, the rates may be permanent. The plan contemplates increasing the workman's earnings as a reward for increased effort by himself. Should the proprietor introduce a new labor-saving machine, it would be economically wrong to continue the old rates, since the increased output of the new machine is not the result of the workman's efforts. Under such circumstances a new base time must be determined and the premiums be based on that.

If the rates have been settled in accordance with this principle there need, however, be no change in them so long as the methods of production remain the same, and indeed there must not be. Such cuts would introduce the objections of piece work and destroy the workman's confidence in the system and with it his incentive to further effort. To cut the rates is to kill the goose that lays the golden egg. It is essential that the limit to the workman's earnings shall be set by his own capacity to produce, and not, as with piece work, by an arbitrary ruling of the office.

It has often been objected that the proprietor may cut the rates if he chooses and that after all the plan still has the same fundamental objection as piece work. True, the plan does not make rate cutting impossible, but it does make it unnecessary and unprofitable. Smaller initial rates than those determined by this principle would have been less profitable to the employer and to cut them when once set would not only lead to less profitable rates, but it would stop further progress by destroying the workman's confidence. Under this plan it is to the employer's interest not to cut, while, as has been shown, under piece work such cuts are sooner or later forced upon him.

With the rates set in this manner we see, thirdly, that with a single limitation we have secured an ideal economic condition—a condition under which and under given methods of production we will obtain the highest possible production and the lowest possible cost, while the workman will receive the highest wages to which he is economically entitled. In other words, we will secure the maximum possible efficiency of plant.

The limitation referred to is this: In all this we are at bottom depending upon the intelligence, ability and initiative of the workman to increase his output. Mr. F. W. Taylor has put into use at the Bethlehem Steel Works a rate-fixing department and a system of instructions to the workmen by which they are told just now to produce the maximum output. With a given amount of material to come off of a given piece of work there is a certain combination of feed, speed, depth of cut and shape of tool that will accomplish the work quicker than any other combination. This combination depends largely upon the material operated upon and upon other conditions, and its determination is a matter of extended inquiry, expert analysis of data and expert calculation. It is not to be expected that the average workman will be able to find this combination as accurately as one specially skilled at it and, where conditions favor, I have no doubt that Mr. Taylor's method will produce still better results than can the unguided efforts of the average workman. Mr. Taylor has devised a system which meets the peculiar conditions with which he was surrounded with remarkable success, but I do not believe that it is of wide application.

Considering the premiums as set in this way and considering also the rates which experience shows to be sufficient, we learn, fourthly, the fundamental defect of piece work—*its initial incentive is too high;* that is, it offers a reward for increasing the output which is larger than is necessary to produce that increase and larger than it is economically possible for the employer to continue to pay. It is from this defect that all the difficulties with piece work spring.

When it comes to the actual setting of the premium rates, it must be owned that our guiding principle gives us but little help, but that is equally true of it as applied elsewhere. The real difficulty we have to face is that, whereas if we have a fence to paint or a roof to shingle, we have a large body of experience to draw upon, in the matter of premiums the body of available experience is small. In the one case the custom of the locality settles for us what rate we must pay, whereas in the other, custom has not yet been established. In this matter I am satisfied that the tendency is to set the rates too high—that is, to set them so high that in the future the employer will be apt to find, as with piece work, that another workman would be glad to take the work at a lower rate if that rate were guaranteed. The premium rates actually paid range between one-third and one-half the wages rates. The former figure for machine shop work I regard as about right, but the latter, except in shops which were under a high state of efficiency before the adoption of the plan, I regard as dangerous. In my own use of the system in Canada the highest rate paid to men was one-third the wages rate, and it ranged from this down to one-quarter, and this rate seemed there to be ample, although the lowest of which I have any knowledge. At the same time everything in the way of wages, salaries and income is on a smaller scale in Canada than here, and the rate would probably be too low here.

A further divergence of practice exists regarding these rates. The usual practice is to give all workmen a fixed percentage of their wages rates—a practice which, of course, makes most of the rates fractional, and thereby adds to the labor of calculating the premiums. Mr. A. A. Fuller, of Providence, R. I., after several years' experience with the system at the Builders' Iron Foundry—which is not a foundry, but a machine shop with a foundry attached—had an opportunity to apply his experience and start anew at the Providence Engineering Works. At the last named place he adopted a fixed rate of 8 cents per hour for all machine shop labor—a rate which is one-third the wages rate for men getting $2.40 a day, and probably averages about one-third for the entire force. This method avoids fractions in the rates, and, moreover, it is divisible by 4, and inasmuch as time records are not kept more minutely than for quarter-hour periods, fractions never enter the premiums at all, which is a great convenience in the bookkeeping. My own practice in Canada was similar to this, except that the rate was uniformly 5 cents per hour, and I had a second rate of 3 cents for apprentice boys. Others, as already ex-

plained, have adopted quite different methods of calculating the premiums.

As regards a general proof that the system really works as outlined, I have always regarded such proof as superfluous. It seems to me about as necessary to prove that water will run downhill as that men will work for money, or that they will work harder for large amounts than for small. It must be remembered that if the system fails to work, the results are simply nil; that is, the results must be either positive or zero, they cannot possibly be negative. Either the system increases output, reduces cost and increases wages or it simply does nothing. In other words, no risk, beyond some trifling initial expense, is involved in giving it a trial.

The question of the extent of the gains made is, of course, a legitimate one. Several tables giving comparisons of the three items affected before and after the adoption of the system have been published and the gains are uniformly greater than would be believed possible. These gains are in fact so large as to excite incredulity. Most men of experience will not seriously consider a system which deliberately proposes to increase output by 70 per cent. while reducing wages costs and increasing daily wages by 25 per cent., and I am satisfied that if the plan did about half as well as it really does its growth would be much more rapid than it is. Apart from exact figures, which are difficult to get, is testimony from many men in many lines of work, which is substantially unanimous in saying that the system works in the manner described, and this testimony is not a matter of geography or nationality.

As is the case with all innovations, many and varied objections have been raised to the plan, some based on fundamental or economic and others on more superficial or practical reasons.

Of these perhaps the most fundamental of all is the one which urges that the workman's time, as such, has no value and that it is economically wrong to recognize any value attached to it by a time-rate payment, the argument being that payment by the piece-work system, or its equivalent, is the only method that can be economically sound.

There are two classes of men who take this view of the value of labor—students of economics and employers. A far more numerous class—the workmen themselves—have no sympathy whatever with this view. No one who earns his own living has any other way of measuring the value of his own labor than by the income which it gives him per day, per month or per year. This is true of all grades of men, from the laborer who carries a hod to the president of the United States Steel Corporation, and it is true of all trades, professions and occupations. Ignoring the difference between the employer's and the employee's view of the basis of value in labor leads to an apparent antagonism between the interests of the two classes where in fact none exists. However much we may believe and say that in a general way the interests of employer and employee are identical, we nevertheless tacitly assume and take for granted that in the matter of immediate wages their interests clash. The relations between them are essentially those of buyer and seller, and as the interests of the buyer are with low and those of the seller with high prices, so, it would appear, are the interests of the employer with low and those of the workman with high wages. This is one of those half truths which is pretty nearly a whole falsehood, and it is a half truth because in this statement we have ignored or forgotten that the parties measure wages in different units. Stating the case fully, it becomes: The employer's interests are with low wages *per unit of product*, while the workman's interests are with high wages *per unit of time*. There is no necessary antagonism of interest here, and under the premium plan the interests become nearly identical. If an employer, through the payment of increased wages per day, can secure reduced wages per unit of product, it is absolutely clear that the interests of both parties have been advanced. If there is any possible basis of united and co-operative action, this plan would seem to provide such a basis.

A second fundamental objection is made from the standpoint of equity. "These gains," it is said, "are due entirely to the efforts of the workman—how then can you justify an arrangement which gives but a part of the gain to him and gives the remaining and even the larger share to the employer?" Such an objection is based on a very superficial view of the matter. An employer who has erected a factory for the manufacture of a certain article may legitimately ask and expect that that factory shall be operated at its maximum capacity, provided he pays enough in wages to induce his workmen to so operate it. More than this, it must be remembered that under this plan the employer is practically asked to guarantee the continuance of the increased wages, while there is no one to guarantee him even his present scale of prices. The laws of competition hold after the introduction of the system as well as before and these laws forbid that any manufacturer, unless protected by patent or other monopoly, shall make any undue profits. We may be very sure that reduction of costs by this means as well as by any other will be followed by a reduction of prices, and that the employer's gain from the operation of the system will thus become a vanishing quantity. At the last, about the only gain which can be left to him is that due to the increased product from a factory of given size, and perhaps not all of that. Ultimately, the gains due to the operation of the system will be divided between the workman and the purchasing public.

Consideration of this fact, instead of disproving, proves the equity of the division and of the principle given for determining the premium rate. If the premiums are to endure they must be based on the principle laid down—that is, they must be large enough to bring about the desired increase in production, but no larger.

Antithetical to the objections of the man who would measure the value of labor exclusively by its product are those of the man who argues that the value of every man's labor is fixed in the market and that to pay more than the market rate is simply to dispense gratuities. The man is in a sense right, but his range of vision is limited. It is quite true that every man's labor has a market set price, but that price will only secure his presence in the factory—it will not secure his best efforts. That he shall do his best is not nominated in the bond, and were it so nominated the provision would be unenforceable.

Based on essentially the same foundation is the common objection of workingmen that the premiums are not permanent but only a temporary affair to be used as a means of showing a man's capabilities and then be removed, while the production obtained under the premiums will still be exacted. This objection was in effect answered above in showing that rate cutting is unprofitable to the employer, but it may be answered more briefly by the statement that the workman is worthy of his hire. All employers pay higher wages to efficient than to inefficient workmen, because compelled to do so. The premium plan simply systematizes this practice and grades, sorts and pays men in accordance with their efficiency, instead of leaving that sorting to general observation and even to favoritism. An employer can no more get the premium output without the premiums than he can get an efficient workman for an inefficient workman's wage.

Finally there comes the man of large experience, who has grown gray in the management of men and of work, and whose knowledge of what constitutes a day's work has become almost intuitive. Such men are safe guides and safe managers and many of them will say, as some of them have said, that the whole thing is chimerical—that it is a workman's duty to do a whole day's work and a foreman's duty to see that he does it; that a competent foreman can tell if a workman is doing a full day's work or not, and that one who cannot tell is incompetent. Such a man will say, further, that if a workman increases his output under the premium offer it is because he was loafing before and that the last thing to do with such a man is to reward him for his previous loafing by raising his wages. The proper thing to do, according to this ob-

jector, is to get better workmen and competent foremen.

It will be seen that this objection is antithetical to and inconsistent with the second one cited. The second objector would give all the gains to the workman, while this one would give him none of them.

The fallacy of this man's argument or statement lies in the limitations of his own training and experience. The whole of his accumulated knowledge of what constitutes a day's work is based on a lifetime of experience with methods of payment which offer no incentive to exertion. He has no knowledge of the magnitude of a day's work under incentives, and his appeal to his lifetime of experience is beside the mark. The men who have tried incentives and found them to fail (if there be any such) are entitled to be heard with respect, but the man who has not tried them can, in the nature of things, know nothing about their value. While he is entitled to his opinions like anyone else, his experience has no application and his evidence as a witness or as an expert has no value, and is, in short, "incompetent, irrelevant and unimportant."

Moreover, granting, for the sake of argument, that a workman should do his utmost and that a competent foreman can determine if he does it, the situation is not changed. The real question is: Do workmen do their utmost and can such foremanship talent as is available determine if they do it? The question is to be decided not with reference to what ought to be, but with reference to what is—not with reference to conditions in an ideal world, but to conditions here. We wish an increase of output. Shall we accept human nature as it is and adapt our methods to the conditions which surround us, or shall we spend our time in a vain search for ideal men and ideal foremen, who are so scarce as to be almost nonexistent?

Finally, please consider the fundamentally different effect of raising wages in this manner and of raising them in any other whatever. It is the object—and the laudable object—of all labor unions to raise wages. Suppose, for the moment, that all should succeed. The prices of all commodities would be raised in proportion, the increased wages would buy no more than before and the final effect would be nil. No more wealth being produced, the average man would be no better off. Suppose, next, that one union—for example, that of the coal miners—should succeed. The result would be an increase in the selling price of coal and the gain of the miners would be at the expense of all consumers of coal. Suppose, finally, that the premium plan should be applied to coal mining (and it has been applied to metal mining in three cases to my knowledge). The result would be an increase in the miners' wages but a reduction in the price of coal. The miners would be better off, but at the expense of no one. They would simply have produced more wealth and have profited accordingly, and instead of injuring consumers, would have benefited them. This sums up the whole philosophy of the system. Through it the production of wealth is increased and in this producers and consumers share alike. If the industrial system of the world is, in a broad sense, simply the co-operative production and distribution of wealth, and if an increase in the total wealth produced, by giving more to divide, increases the amount available for each individual, then the general adoption of the premium plan can do nothing less than advance the prosperity of all.

A Diagram for Laying Out Spiral Gears.

BY J. N. LE CONTE.

The many articles which have appeared in the AMERICAN MACHINIST during the past few years on the subject of spiral gears suggest a few points which may be of interest to the reader. In the first place it would appear that the diameters of the gears used in filling a fixed distance between shafts may be made to depend on the tooth angles which give the maximum efficiency, or the least work lost by friction. These angles, as have been pointed out by Mr. F. A. Halsey (AMERICAN MACHINIST, Vol. 21, page 24) lie in the neighborhood of 45° in the case where the shafts cross at right angles, being 43° 34′ when the friction of the gear alone is taken into account, and 52° 49′ when the friction of both gear and step are considered. A series of calculations undertaken by the writer would make it appear that the tooth angle should bisect the shaft angle in all cases, which would make it exactly 45° in the above instance. Practically, however, the difference is insignificant, especially as in the article referred to the efficiency appears to change but slightly for considerable variation of angle on each side of this maximum. Having chosen then the tooth angle of our gears, the radii can be calculated from the well-known formulas:

$$R_1 = \frac{K \cos.\ \beta}{y \cos.\ \alpha + \cos.\ \beta}$$

and

$$R_2 = K - R_1$$

where R_1 and R_2 are the pitch radii of the gears, α and β the corresponding spiral angles, K the fixed distance between shafts, and y the angular velocity ratio.

As soon as these are fixed, we are confronted by the still further limitation that the numbers of teeth on both wheels must be whole numbers. If P is the diametral pitch of the rotary cutter and N_1 and N_2 the numbers of teeth on the two gears,

$$N_1 = 2\ P\ R_1 \cos.\ \alpha,$$
$$N_2 = 2\ P\ R_2 \cos.\ \beta.$$

The numbers of teeth thus obtained will not in general be whole numbers, but we must choose the nearest whole numbers to the ones obtained, and recalculate the angles and radii to fit the new case, as has been shown in previous articles. The direct solution of this depends upon the solution of the equation:

$$\frac{N_1^1}{\cos.\ \alpha} + \frac{N_2^1}{\cos.\ (\delta - \alpha)} = 2\ P\ K$$

In which N_1^1 and N_2^1 are the nearest whole numbers of teeth to the calculated ones, and δ is the shaft angle, or $\delta = \alpha + \beta$. As is well known, this equation cannot be solved by any simple means, for it is of the fourth degree, and, though possible of solution, such solution is not practical. Furthermore, there are four real values of α which will satisfy it. Graphic methods of solution, or continued approximations, must then be resorted to. The best graphic method appears to be that given by Mr. Robt. Bruce in the issue of the AMERICAN MACHINIST, Vol. 23, page 345. The appended diagram gives a method by which the angle can be read off directly. Having obtained the nearest whole numbers of teeth on the gears, find on the diagram the point G whose co-ordinates are $\frac{N_2^1}{2\ P\ K}$ and $\frac{N_1^1}{2\ P\ K}$ on the inner scales. Through this point draw a line or merely lay a straight-edge tangent to the curve representing the shaft angle. The outer scales on the bottom and left will give roughly the angles α and β respectively, and the inner scales the values of cos. α and cos. β quite accurately. The radial lines of velocity ratio will facilitate the location of the desired point, for if the ratio be one of those given, the point must lie on its line. It will also be noticed that for shafts crossing at 90° the position of the line gives the desired angles at its two extremities.

It is interesting to note that two lines can be drawn through a given point tangent to the curves, as shown. As a matter of fact, four such lines could be drawn provided the whole of the curves were laid in, but that portion shown is the only portion giving positive angles, *i. e.*, angles within the angle δ. But there will be two separate positive values of the angle α, which, with a given velocity ratio, number of teeth and shaft distance, will work correctly together, giving of course different values of the radii. Which of these is the one required can always be told as lying nearest to the first approximation of the angle. (The same result is seen in the case of Mr. Bruce's solution. Two positions of the line AE of his Fig. 4 can be found passing through O where the length is 11 inches.) If the point G lies on one of the curves, the two positions coincide (a limiting case), and if it lies on the concave side the solution is impossible within the angle δ.

As an example of the use of the diagram, take the oft-quoted case of Mr. De Leeuw (Vol. 23, page 30). Here $y = \frac{\omega_1}{\omega_2} = \frac{1}{4}$, $N_2^1 = 8$, $N_1^1 = 32$, $K = 4.468''$, $\delta = 90°$, and $P = 6$. Then $\frac{N_2^1}{2\ P\ K} = 0.149$, $\frac{N_1^1}{2\ P\ K} = 0.596$. These co-ordinates give the

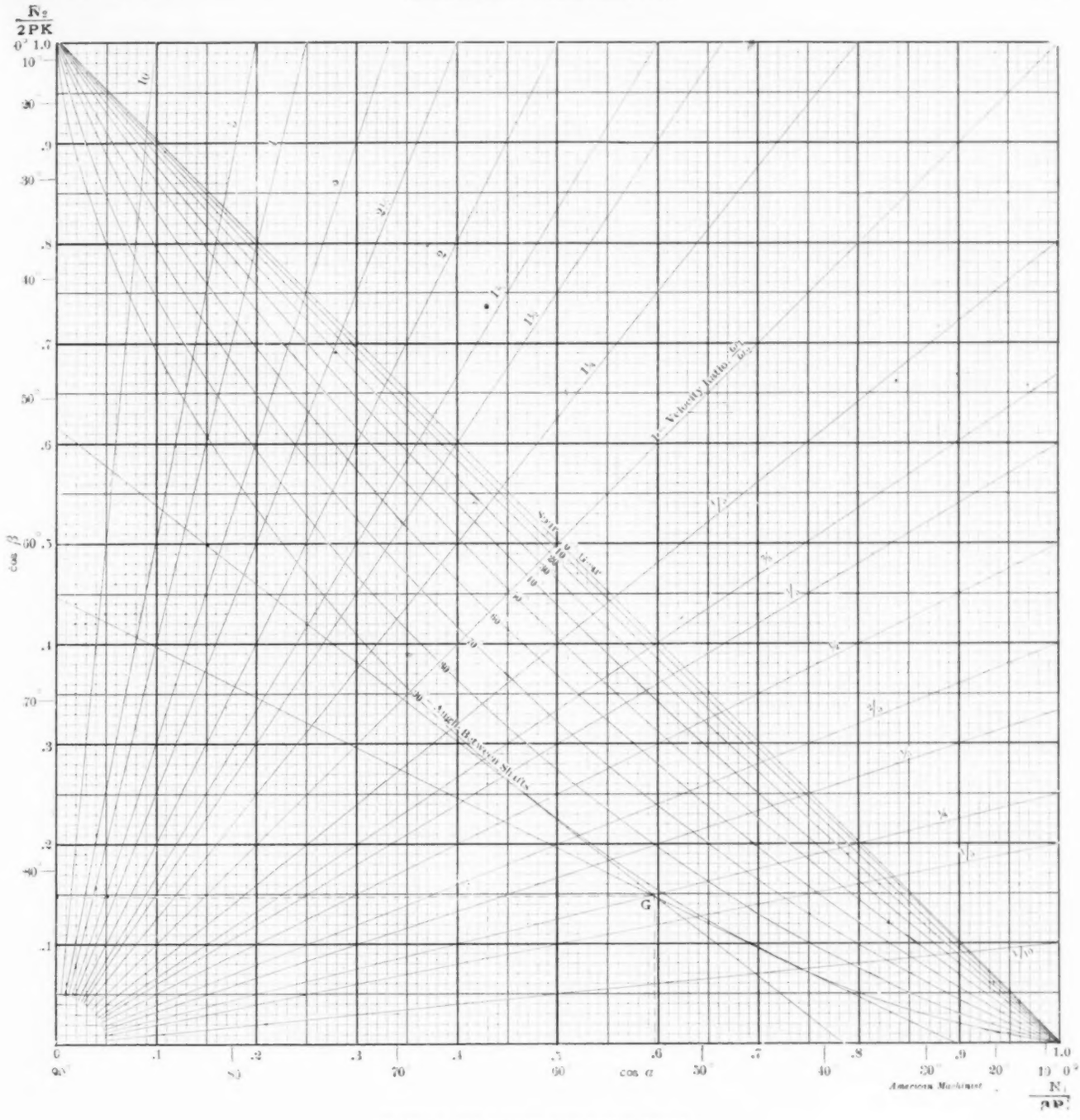

DIAGRAM FOR LAYING OUT SPIRAL GEARS.

point G on the diagram. A line through G drawn tangent to the lower part of the 90° curve gives quite accurately cos. α = 0.894, and cos. β = 0.447, or:

$$\alpha = 26^\circ\ 35'\text{ and }\beta = 63^\circ\ 25',$$

agreeing quite closely with the result derived analytically. If the second line be drawn through G tangent to the upper upper portion of the curve, it gives: cos. α = 0.787 and cos. β = 0.617, or:

$$\alpha = 38^\circ\ 61'\text{ and }\beta = 51^\circ\ 54'.$$

These fulfill the requirements, for sec. (51° 54′) + 4 [cosec. (51° 54′)] = 1.6206 + 5.0828 = 6.7034.

There is but one more question which may be mentioned, and that is as to the selection of the cutter for the spiral gear. If we consider a helix drawn upon a cylinder and then imagine a plane cutting that cylinder normal to the helix at any point, the plane will cut from the cylinder an ellipse having one extremity of its minor axis at the point where the helix is cut by the plane. The minor axis of this ellipse will be $2R$ and the major axis $\frac{2R}{\text{cos. }\alpha}$. If we cut a spiral gear in the same way at a point midway between two teeth, the form of the space shown will be the true normal shape which the cutter must be, and the above ellipse will be cut from the pitch cylinder. Now the curvature of this normal section of the gear at the point indicated must be the same as the curvature of the ellipse at the extremity of its minor axis. If we call the major and minor axes of an ellipse $2a$ and $2b$, respectively, the radius of curvature at the extremity of the minor axis is $\rho_0 = \frac{a^2}{b}$. But in our case $a = \frac{R}{\text{cos. }\alpha}$, and $b = R$, hence:

$$\rho_0 = \frac{R}{\text{cos.}^2\ \alpha}.$$

This is the *radius* of what might be called the "osculating spur gear." The number of teeth on this gear will be:

$$N_0 = 2P\rho_0 = \frac{2PR}{\text{cos.}^2\ \alpha}.$$

But on the spiral gear itself we have:

$$N = 2PR\text{ cos. }\alpha$$

Hence:

$$N_0 = \frac{N}{\text{cos.}^3\ \alpha}$$

and not $\frac{N}{\text{cos.}^2\ \alpha}$, as sometimes stated.

In conclusion it will appear that the best angle for a spiral gear tooth is that bisecting the shaft angle. When the number of teeth deduced from this is not a whole number, it will be best to choose from the two whole numbers between which it lies, that tending to most nearly equalize the diameters. The above values are not claimed to be rigidly correct for anything involving so variable a factor as the coefficient of friction. They are only intended to point out a reasonable ground for choice of angle when other features of the general design do not interfere.

The Plastic Pressure Tube Expander.

A new tube expander has recently been patented by C. V. Burton and is manufactured by the Newall Engineering Company, Ltd., 36 Featherstone street, London. This expander operates by forcing a lead bushing against the inside of the tube in such a way that the lead flows under the expanding pressure and stretches the tube slowly and uniformly until the joint is made perfectly tight. The amount of expansion is not under the control of the operator so that there is no danger of the tubes being over-expanded on account of poor judgment on the part of the workman. The tubes can be expanded with a bell-mouth outside the tube sheet and bulged more or less inside, or the expansion can be confined entirely to the thickness of the plate. There is no difficulty in expanding satisfactorily the smallest sizes of tubing which would make the process of interest to automobile builders and others dealing with small tube apparatus.

Fig. 1 shows the smallest size on the market at present, which is 3½ inches in diameter and 10 inches over all in length. The length can, however, be reduced somewhat where the circumstances require it.

Fig. 2 is a section of the small hydraulic press that pulls on the mandrel *M* and by distorting the lead bushing *L* exerts a perfectly uniform pressure on the inside of the tube. The piston or ram *O*, Fig. 2, has three rods *R* which support the bolster *B*. The mandrel *M* is screwed to the front head of the cylinder *A*, so that with the bolster *B* resting against the end of the tube the press operates to withdraw *M* against the resistance of the lead.

Fig. 3 shows some interesting details of the valve chamber *V*, Fig. 1, through which the press is controlled. The water under pressure comes in through *J*, being carried by a soft copper pipe about 3-16 inch bore. *J* forms a kind of swivel so that the copper leader shall not be twisted by movement of the press. From *J* suitable passages carry the water to the pressure chamber *P*, which is separated from the chamber *I* by a wall having a seat for the valve *G*. The plug *N* which closes the chamber P has a guide formed on the end on which the valve *G* slides and a spring *Q* aids the excess of pressure in *P* to hold *G* against the seat. *G* has also a face at the right-hand end and a seat is formed on the end of *R*, so that with *R* screwed against *G* the passage through *R* will be closed. In the position shown in Fig. 3 the passage is open so that the water in the press cylinder can pass out through the exhaust hose *W* attached to the outer end of *R*. A slight turn of *R* by the handle *S* will close the exhaust opening and a further movement will lift the valve *Q* off its seat and allow the water from *P* to flow into the cylinder and move the ram. About one-half turn of *S* is all that is necessary to completely control the motion of the piston. The ram is returned by hand after each stroke.

Fig. 4 shows the mandrel with the lead on the shank ready to put into the tube. The head of the mandrel is about 1-32 inch smaller than the inside of the tube, and the lead almost fills the space between the neck of the mandrel and the wall of the tube. Fig. 5 shows the parts in place ready for expanding, and in Fig. 6 the expanding is partially completed. Fig. 7 gives the position of the bolster and mandrel at the end of the operation. It will be noticed that the extruded lead has forced the bolster away from the tube end, leaving the expander entirely free. The lead is removed by the tool, Fig. 8, leaving the tube, as indicated in Fig. 9. The hook *H*, Fig. 8, has the handle *T* formed solid with the shank, and the sliding weight *K* can be used as a hammer with which to strike the front end of *T* and so pull out the lead which comes away whole and shows little tendency to stick to the tube.

The bulging of the tube inside the sheet is controlled by the proper selection of the length of the lead bushing, a longer bushing increasing the bulging. If it is necessary to avoid the bell-mouth on the tube and yet have the tube project from the sheet, the expanding must stop before the end of the tube begins to spread and the pressure be released so that the bolster may be partially withdrawn and a "dis-

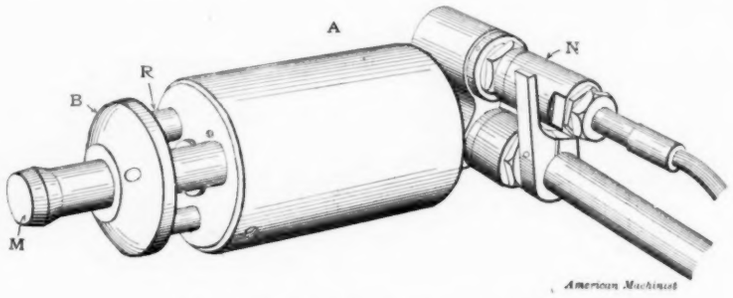

FIG. 1. GENERAL VIEW OF THE PRESS.

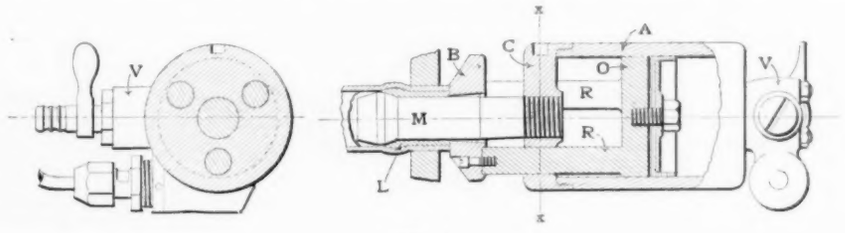

FIG. 2.

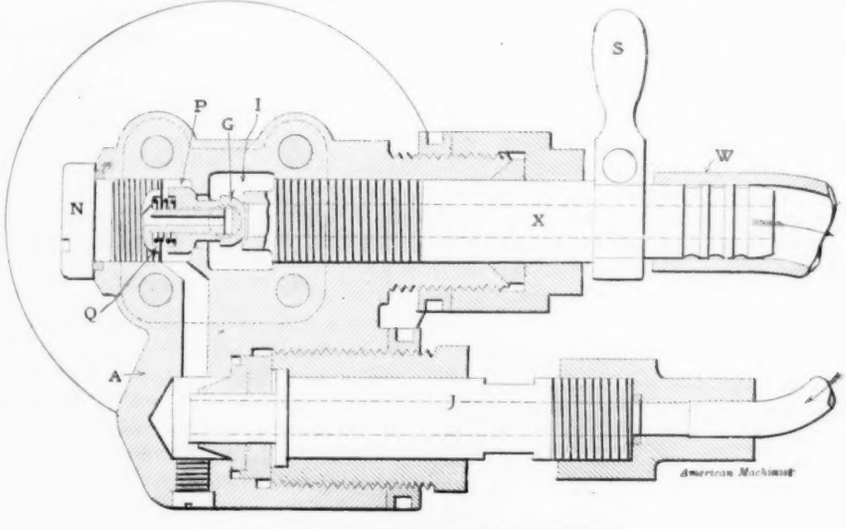

FIG. 3. SECTION THROUGH VALVE CHAMBER.

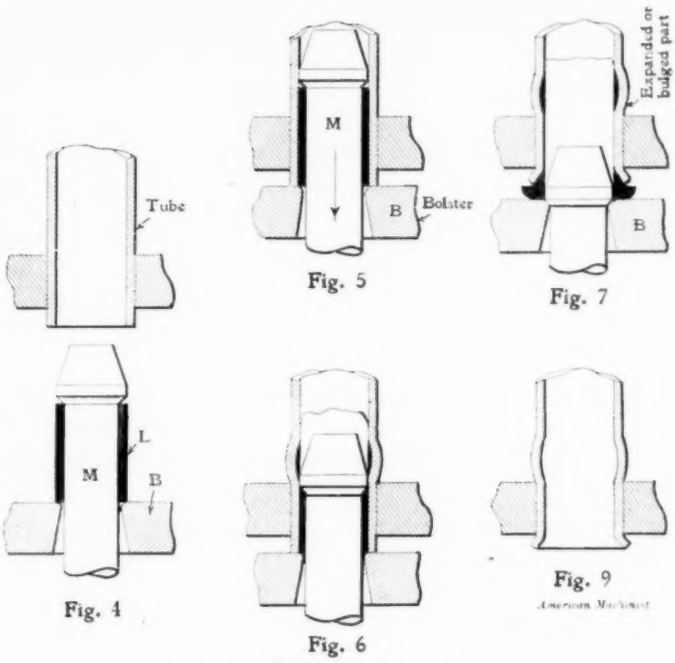

Fig. 4 Fig. 5 Fig. 6 Fig. 7 Fig. 9

American Machinist

SECTIONS SHOWING WORK IN VARIOUS STAGES.

charger" inserted between the plate and bolster, after which pressure is again put on, withdrawing the mandrel and most of the lead.

The lead bushings are made in halves and are cut from sheet lead weighing from 6 to 9 pounds per square foot. The expense for lead is represented by the difference in price between sheet lead and scrap.

The working pressure naturally varies with the size of the ram and the size and thickness of the tubes, but the small expander requires for 1-inch tubes from 1,450 to 1,800 pounds per square inch, and 2,250 to 2,800 pounds for 1½-inch tubes. The quantity of water necessary for a full stroke of the small expander is 13.4 cubic inches, and the tool complete weighs 13 pounds. Three sizes are listed by the makers, varying in capacity from 0 to 1⅝ inches for the small size up to 4¼ inches for the large size, or with a maximum of 7 inches by a slight change in the form of the bolster. The comparatively small quantity of water needed makes the operation by a hand pump possible where there is no regular hydraulic service obtainable, and even then the time necessary for expanding a joint is very short. With water service under pressure the time is from 35 to 40 seconds per joint.

The samples of work shown in Fig. 10 will give an idea of the appearance of tubes expanded by this process. *A* is a tube that was 1-32 inch slack in the hole before expanding and was expanded with a slight bell mouth. *B* is a similar tube, 1⅜ inches diameter, but was 1-16 inch out of round before expanding. This sample was expanded in 35 seconds and afterwards tested to 3,000 pounds per square inch before there were any signs of leakage. There is no bell mouth to this tube.

C is a section through a 1½-inch copper tube expanded into a recess in the sheet. The copper part of the other half of this sample shows on the outside surface the impression of the marks left in the recess in the sheet by the recessing tool.

D is a ⅞ steel tube expanded with a large bulge inside the plate and a large bell mouth.

The samples *A* and *B* might be subject to the criticism that the holes in the tube sheet are much larger in relation to the diameter of the tube than is considered good practice. It is on this account that these samples show the enlargement back of the plate, as the tubes are expanded without any bulge inside the sheet.

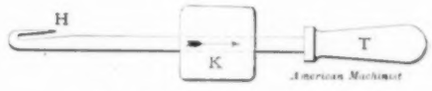

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FIG. 8. TOOL FOR EXTRACTING LEAD.

Waterproofing Blueprints.

The waterproofing medium is refined paraffin, and may be applied as follows: Immerse in melted paraffin until saturated a number of pieces of an absorbent cloth a foot or more square, and when withdrawn and cooled they are ready for use at any time. To apply to a blueprint spread one of the saturated cloths on a smooth surface, place the dry print on it with a second waxed cloth on top, and iron with a moderately hot flat-iron. The paper immediately absorbs paraffin until saturated and becomes translucent and highly waterproofed. The lines of the print are intensified by the process, and there is no shrinking or distortion. As the wax is withdrawn from the cloths more

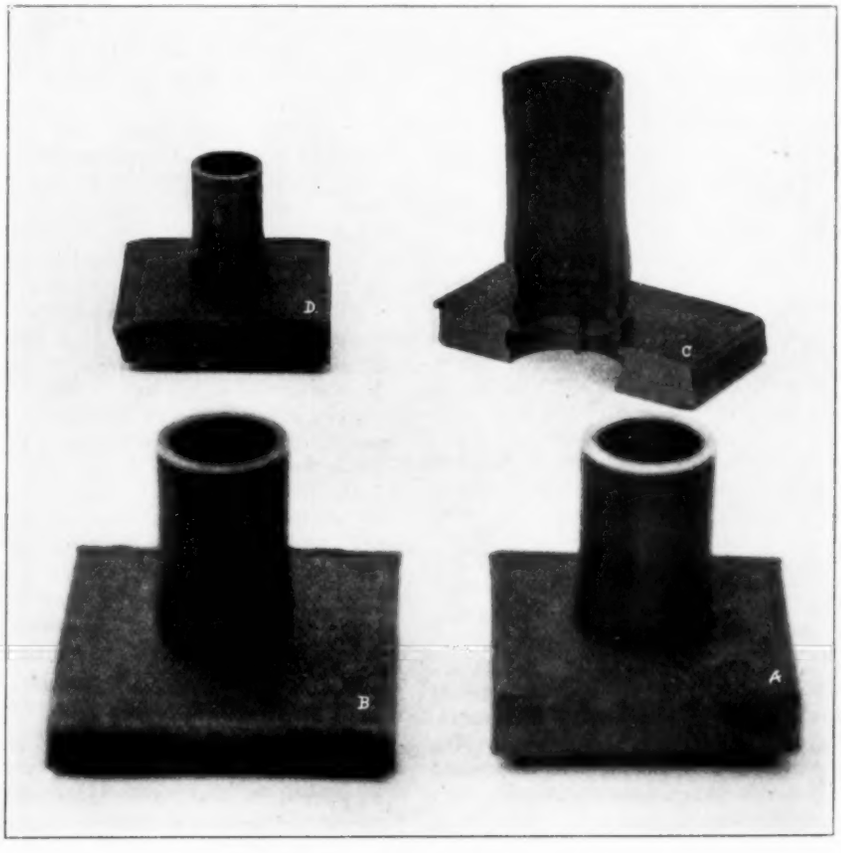


FIG. 10. SOME SAMPLES OF WORK DONE.

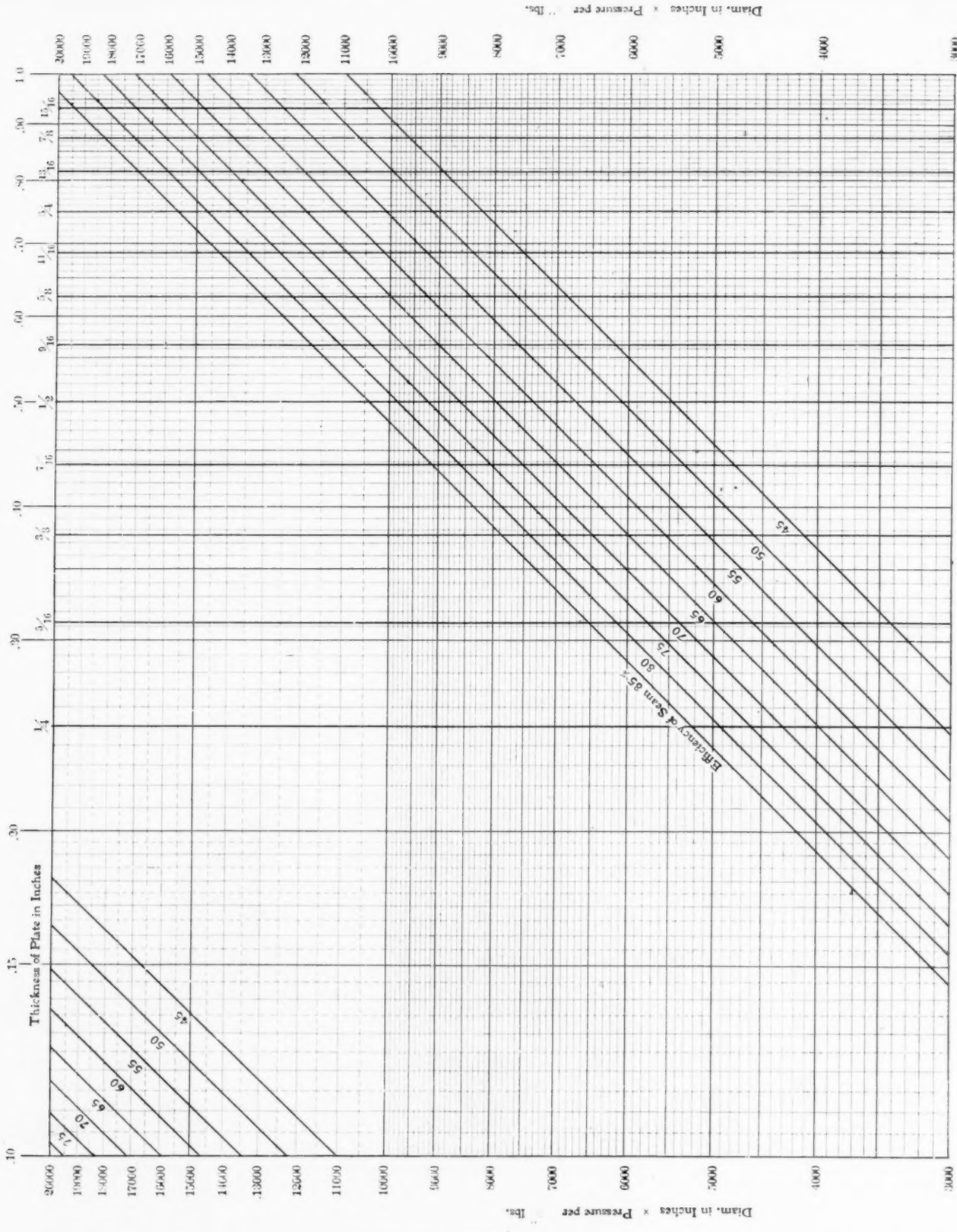


DIAGRAM FOR FINDING THE THICKNESS OF BOILER PLATES.

can be added by melting small pieces directly under the hot iron. By immersing the print in a bath of melted paraffin, the process is hastened, but the ironing is necessary to remove the surplus wax from the surface, unless the paper is to be directly exposed to the weather and not to be handled.—*Mines and Minerals.*

Diagram for the Thickness of Boiler Plates.

BY JAMES A. BROWN.

The table of thickness of boiler plates at page 92, apart from its intrinsic value, is of interest in showing the tendency to work out and tabulate all data in constant use in any particular line of work. It is also of value in showing the standard practice of a prominent manufacturer. It will be noted that the table applies to but two forms of joint giving efficiencies of 75 and 85 per cent. with factors of safety of 3.97 and 4.5. A diagram in more general terms might be useful to your readers engaged in lines other than locomotive work.

While all the factors entering the design

of a riveted boiler joint are interdependent they may be roughly separated into two groups: those that determine the efficiency of the joint and those that determine the thickness of the plate.

Those of the first group are: (a) Form of joint, (b) relative strength of plate and rivet, (c) diameter of rivet, (d) pitch of rivet.

The factors determining the thickness of plate are: (a) Ultimate strength of plate, (b) diameter of boiler shell, (c) pressure per square inch, (d) factor of safety allowed.

To determine the strength and efficiency is the real problem in designing a joint. Proportions determined from theoretical considerations alone have comparatively little value. The more recent discussions have been based on the Watertown Arsenal experiments, in which the results obtained have shown that the strength and efficiency can be properly determined only from tests on full-sized specimens. This has led to the use of the term "apparent efficiency" when discussing the calculated values of joints. The apparent efficiencies of some of the more common forms of joints are about as follows:

	Per cent.
Single-riveted lap joints	45 to 55
Double-riveted lap joints	55 to 65
Single-riveted lap-joint inside cover plate	65 to 75
Double-riveted lap-joint inside cover plate	70 to 80
Double-riveted butt joint	70 to 80
Triple-riveted butt joint	75 to 85

These figures are only approximate, but with good material and workmanship may be considered rather conservative.

Knowing the efficiency of the joint, the thickness of plate may be found from the second group of factors which are combined in the diagram, which is based on an ultimate tensile strength of 55,000 pounds and a factor of safety of 4.5. The vertical columns of figures give the product obtained by multiplying the diameter of shell in inches by the pressure per square inch in pounds. Tracing horizontally from the proper product to the diagonal for the given efficiency and then vertically gives the thickness of plate required at the top of the diagram. The heavy lines give the thickness in binary fractions of an inch. As an example, take a shell 75 inches diameter, 200 pounds pressure, to find the thickness of plate required, the joint having an efficiency of 85 and 75 per cent.

$$75 \times 200 = 15{,}000.$$

A horizontal line from 15,000 intersects the line for 85 per cent. efficiency at .72, the nearest higher fractional size being ¾ inch. At 75 per cent. efficiency the thickness is just 13-16 inch.

In piping for gas (not long) allow two circular eighths of an inch of section for each light.

Letters From Practical Men.

That "Difficult Case."

Editor American Machinist:

As an employer and a past employee in engineering circles, I should esteem it a favor if you would allow me a little space in your valuable paper for the purpose of showing how I would treat such a case as described by "Needle"; it is obvious that there must be a remedy. During the past ten years I have had considerable and lively experience with the "ignorant and profane." I have won in every case, but I must admit the game does not suit everyone who aspires to climb the ladder of promotion by inaugurating modern tools and methods in antiquated shops.

And now to my method. When appointed to a position I invariably used to sing "low" until I knew the routine of the shop, etc.; and in this case I imagine that "Needle's" friend had given some information of his intentions to those in his charge. Anyhow, when I had found out that such a conspiracy existed, as we are told did, I should have approached the management, laid the matter before them and urged the necessity of laying in a month's stock of fittings, so that the affected department would be, so to speak, a month ahead of the other departments. This could be done either by overtime or night shifts. I never met a management who thought more of a few dollars than of the notion that the shop's output would by the sacrifice be permanently increased. When I had that stock of fittings in hand I should "beard the lion." By that time I should have a very good idea of the routine of the shop and who was eligible for promotion. Also during the month the management would assist me by making inquiries for suitable men to fill the expected gaps. When all was ready I should have the "conspirators" brought before the staff and the "profane gentleman" would be instantly dismissed after laying bare the scheme they had concocted. I doubt whether the remainder would leave *en masse;* my experience teaches me, not. However, if they did, what matter? You have reserves. In a business in which the writer states "he should judge the competition to be quite close" one would naturally expect labor plentiful. I should not have deserted the ship, and why the president of that shop should have given "Needle's" friend an excellent recommendation and want to see him again, puzzles me. I do think that our friend did what was perhaps best for himself. He evidently wasn't equal to the occasion. It does require some determination, and a man is better out of the ring who hasn't got any. As an employer my fighting days are over; at least, I presume so. Yet I stand back to back with my foreman and expect the same from him, but when I read of cases like "Needle's" my back is up, and I should simply revel in assisting to crush such combinations as described. TRUE BLUE.

England.

Editor American Machinist:

That "Difficult Case," which has been perhaps sufficiently discussed in your columns, reminds me of a story told by a certain railroad manager as embodying one of the means of his success. He was once called to the management of a certain road, and the road had one station where freight congested badly, and only one man had been found who could and did keep things moving right. This man had a bad habit. About twice a year, for three or four days, he would get drunk. They had put up with this for a considerable time, thinking it more profitable to have trouble occasionally than to have it all the time. The new manager happened to take charge during one of the times of derangement. Freight was piling up, and he asked what was the cause. He was told the man was drunk, and he said at once: "Discharge him." They said that wouldn't do, as he was the only man, etc., etc. "Well, then, what would you do if he should die?" They didn't know. "Well, just consider him dead, then." It looks as if it would have been a good place for two foremen to consider themselves dead. G. E. H.

Saginaw, Mich.

Editor American Machinist:

"Deliver me from my friends," I think I hear *my* friend exclaim when he opens his AMERICAN MACHINIST and reads the storm of criticism which I have brought about his ears, and, as the author of "A Difficult Case," I ask for sufficient space to set up a defense.

In spite of the harsh tone of most of the criticisms, they are on the whole very amusing, not the least entertaining feature being the manner in which the critics guess at certain things, assume that their guess is correct and immediately jump to the conclusion they *wish* to reach; consequently we find "maybes" in swarms and "might have beens" too numerous to mention. Listen, for instance, to Frank Rattek! By the simple process of promoting A, giving B a "raise" and to C the very hazy and indefinite remark that he "would like to give him something," and entirely ignoring D, E and F, "the entire department would be run cheaper than formerly, the output would be increased, and A and B would inevitably bring order out of chaos." Truly a milennium (on paper) while you wait. If Mr. R. could only make a few changes and alterations in human nature his scheme would stand a fighting chance of success.

Mr. Morgan assumes that eighty *operatives* means eighty *men*. As a matter of fact, the majority were girls and boys, and while there may have been "four men just as intelligent and just as expert," there certainly was not one "knowing just as well where to find the tools," for the sim-

ple reason that it was part of the conspiracy to keep them ignorant of this very thing. Then he (Mr. Morgan) "would have the salaries of four men to distribute among the operatives." But why stop with fo r men? Why not include the superintendent and president? No doubt, among the 800 hands employed, there are two men "just as expert and just as intelligent," and *presto!* he has the salaries of two more to add to his four, and so on *ad infinitum.* To puncture the bubbles blown by the other critics would involve too much detail and explanation of conditions of which they are ignorant, so that must be set aside for the present in order that I may say a few words in justice to my friend.

In the first place, he accepted the position in ignorance of existing conditions, which were known, at least in part, to the management. Upon discovering these conditions he did the very thing which Mr. Green says he should have done, and immediately censures him for not doing, viz.: he reported the state of affairs to the management. At the office consultation he offered to stay, upon certain conditions which would merely protect him in case the management weakened and were disposed to yield to the foremen and sacrifice him, which conditions were rejected, thus disposing of the assumption of "X. W. Z.," that he had the "thorough backing of the management." The "good position open to him" offered prospects equal to those of the one he left, besides the additional advantages of being in the city where his family was settled, where he had lived for many years and was familiar and satisfied with conditions of life. Add to this the fact that the company offering him the position required an answer within a reasonable time, and presumably would not have consented to await the outcome of his missionary labors in another field, and in my humble opinion in deciding as he did he showed his possession of a quality which would have been necessary to his success in his first position, viz.: good "horse sense." NEEDLE.

Finding Centrifugal Force by the Slide Rule.

Editor American Machinist:

I have read Mr. Armstrong's very interesting article on the slide rule for finding centrifugal force at page 99 and am only sorry that he did not illustrate his method with an example showing how he arrived at his finished result.

The matter of centrifugal force comes up in the locomotive business in connection with the strength of the connecting rods. A main rod of a locomotive will sometimes weigh as much as 1,000 pounds, and in a fast engine the fiber stress is frequently made up more largely from the centrifugal force than from the piston thrust. It follows that a good deal of nice calculation has to be done on these parts.

From "Kent's Pocket-book," page 423, I take the following formula:

$$F = .0003410\ W R N^2,$$

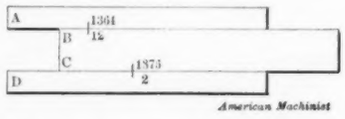
in which F = centrifugal force, W = weight in pounds, R = radius in feet, N = number of revolutions per minute.

If we divide by 12 to reduce R in feet, to r in inches, and change the form of the equation, we have:

$$F = \frac{W r}{3.52 \left(\frac{N}{100}\right)^2}$$

which, I believe, is the form of the equation used by Mr. Armstrong.

Mr. Armstrong's method requires the slide to be inverted and a reading taken after which the slide is changed back again



SLIDE RULE SET FOR SOLVING PROBLEMS IN CENTRIFUGAL FORCE.

to its normal position and a second reading is taken. The problem may be solved without inverting the slide and by one reading. To do this we put the equation in this form:

$$F = \left(\frac{N}{187.6}\right)^2 W r$$

and set the rule as shown in the sketch, which is set for $N = 200$ and $W r = 12000$. The procedure is: Over the revolutions on D place 1876 on C and over the product of the weight and the radius in inches on B find the answer on A. If the product $W r$ is too great to be found in the head, solve the problem in two readings thus:

$$(200 \div 187.6)^2 \times 24 = 27.28$$

and $$27.28 \times 500 = 13640.$$

GEORGE F. SUMMERS.

Schenectady, N. Y.

A Few Graphical Methods of Figuring.

Editor American Machinist:

The article on "A Few Graphical Methods of Figuring," at page 62, presents certain graphic solutions whose geometrical accuracy cannot be denied. But why should graphic methods be applied to the calculations covered in the first five constructions?

Almost every engineering pocket book contains a table of circumferences and areas of circles, the diameters usually advancing by unity from 1 to 1,000. By mere inspection such a table will give a result accurate to within less than 1 per cent. of the diameter, and by interpolating a still closer approximation, say to within less than 0.01 of 1 per cent. can be obtained. The maximum unavoidable error is undoubtedly much smaller in the case of the table than in the case of the graphic construction, and I am convinced that for any given degree of accuracy the table also has the advantage in regard to speed.

The last of the six problems (required the length of the side of a regular polygon of n sides and area A) seems to me to be the only one for which a graphic solution would be advantageous. The proposed construction, however, is somewhat cumbersome, and I submit the following method, which is simpler and therefore more accurate.

Using the notation of Mr. Fanning:

Let A = given area of a regular polygon
n = given number of sides,
y = required length of side.

From these Mr. Fanning deduces the equation:

$$A = \frac{n y^2}{4 \tan. \frac{180°}{n}}$$

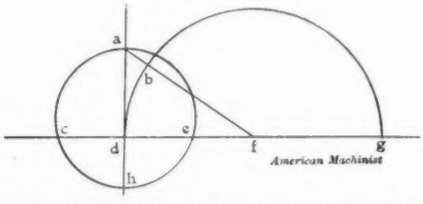
which may also be written:

$$y^2 = \frac{4 A}{n} \tan. \frac{180°}{n}$$

or $$y = 2 \sqrt{\frac{A}{n} \tan. \frac{180°}{n}}$$

And the problem is solved if we determine this last value.

With radius $\frac{A}{n}$ draw the semicircle $d\,b\,g$, using any convenient scale. Draw the diameter $d\,g$; extend it indefinitely in either direction, and erect the perpendicular $d\,a$, likewise extended indefinitely. Lay off $d\,h = 1$, using the scale with which the radius of the semicircle was measured. Divide the semicircle into n parts, and let $d\,b$ be the first of these divisions. Draw the radius $f\,b$, and extend it to a. Draw the circle $a\,e\,h\,c$, having its center on $a\,d$, and passing through a and h. Then $c\,e$ is the required length of side.



FINDING THE SIDE OF ANY REGULAR POLYGON HAVING A GIVEN AREA.

Proof: As $c\,d$ is a mean proportional between $d\,h$ and $d\,a$,

$$d\,h : c\,d :: c\,d : d\,a$$

But by construction $d\,h$ is unity, and hence

$$1 : c\,d :: c\,d : d\,a$$
$$c\,d^2 = d\,a$$

But $$d\,a = d\,f \tan. \frac{180°}{n}$$

and as $d\,f$, the radius of the semicircle, was made equal to $\frac{A}{n}$,

$$d\,a = \frac{A}{n} \tan. \frac{180°}{n}$$

hence $$c\,d^2 = \frac{A}{n} \tan. \frac{180°}{n}$$

or $$c\,d = \sqrt{\frac{A}{n} \tan. \frac{180°}{n}}$$

$$c\,e = 2\,c\,d = 2 \sqrt{\frac{A}{n} \tan. \frac{180°}{n}}$$

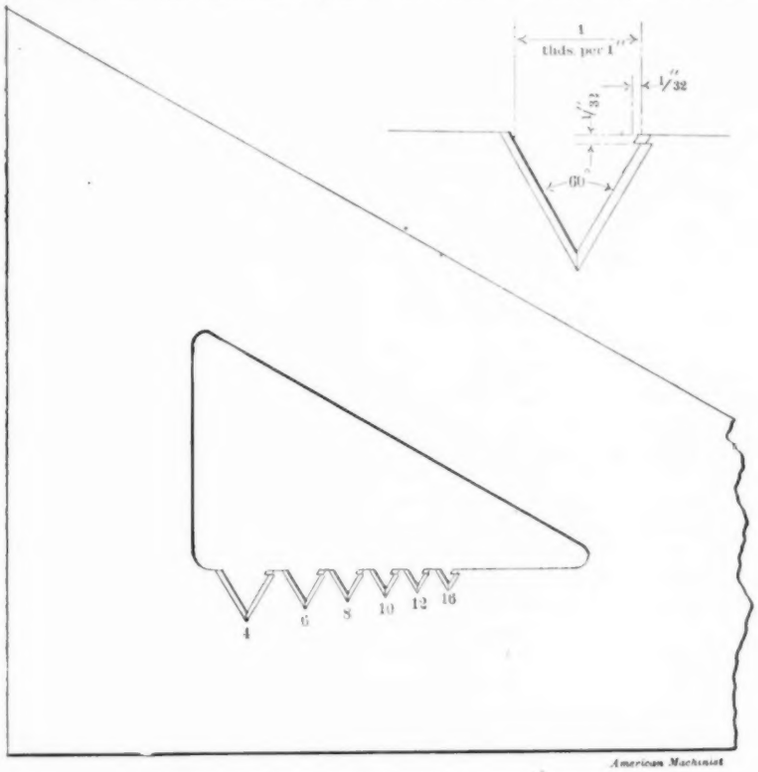
but this is equal to the value obtained above for y, and therefore $cc = y =$ required length of side of regular polygon.

EDGAR H. BERRY.

An Instrument for Drawing Screw Threads.

Editor American Machinist:

I believe that the simple device for laying out screw threads shown herewith will make interesting reading for a lot of draftsmen who do not like to do this kind of work and who are justified in using conventional forms wherever possible: File a series of 60-degree notches in a triangle, making the width at the top equal to 1 inch divided by the pitch and leaving a small point to stop the pencil. I use 4, 6, 8, 10, 12 and 16 pitch, making the notches ¼, 1-6, ⅛, 1-10, 1-12 and 1-16 inch wide. To use the instrument, place



AN INSTRUMENT FOR DRAWING SCREW THREADS.

the pencil against the left side of the notch, run down that side and up the other to the stop; then move the triangle along to the right until the pencil is again against the left side; repeat as many times as desired. A uniform rapidly made thread results.

ROGER HAINES.

Cutting Square-Threaded Screws.

Editor American Machinist:

I have been perusing with great interest the articles in your recent issues relating to the cutting of square threads. I am somewhat surprised, however, considering how thoroughly the subject has been dealt with, that no one has pointed out the theoretical reason that makes it impossible to cut a square thread. All that your contributors have demonstrated is the operation required to cut a groove with parallel sides, but by achieving this the width of the actual thread itself is not made uniform, and consequently the term "square thread" is really a misnomer. My meaning will be made clearer by a glance

Fig. 1 Fig. 2

American Machinist

EXTREME CASES OF A SQUARE-THREADED SCREW.

at the accompanying diagrams. Fig. 1 shows a bar with grooves inserted, and, having no pitch, the sides of the collars must be and are parallel. Fig. 2 is the end view of a bar turned with a thread

of such an abnormal pitch that the grooves appear as straight lines; and from this it will be seen that the threads instead of being square are of a triangular shape. The greater the pitch the greater the variation of the sides of the thread from being parallel.

Perhaps this is a phase of the subject that is not always considered. W. B.

Salford, England.

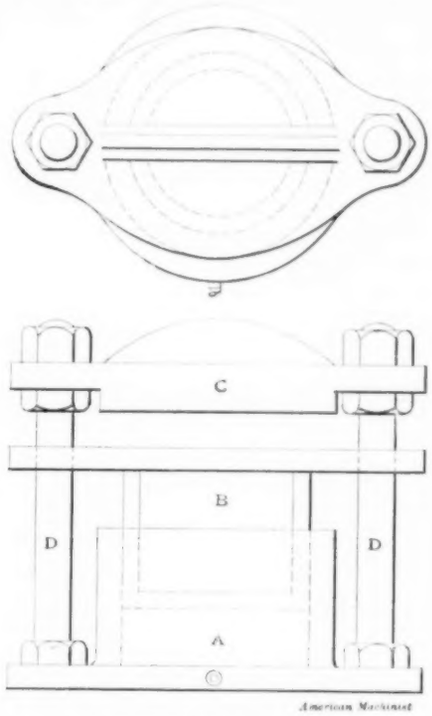
[This is largely a matter of what is meant by a square thread. By that term we understand, as we think most others do, a thread which is square when cut in the plane of the center line. Such a thread has a truncated V-shape when cut perpendicularly to the thread, and the steeper the pitch the more pronounced is the V.—Ed.]

A Leather Forming Press.

Editor American Machinist:

Mr. A. D. Gage, page 99, Vol. 25, asks for some information about leather forming presses. The following is a description of those used by a concern making their own packings in large quantities from ½-inch flange packings to 24-inch cups. I regret that I cannot give dimensions and cost of the pump and accumulator, but, as several manufacturers of hydraulic machinery advertise in the AMERICAN MACHINIST, I think they would gladly supply such information.

As to the manufacture of packings, my experience is that compressed air as a power fulfills all requirements for small and moderate sized work, and several small presses, one of which is shown in the accompanying sketch, have been operated by compressed air for several years, giving perfect satisfaction on work up to



A LEATHER FORMING PRESS.

8 inches in diameter. *A* is a cylinder 8 or 9 inches diameter and about 5 inches stroke; *B* is its piston turned to an easy, air-tight fit; *C* is a plate supported by the rods *D*. A three-way cock, not shown, should be used to admit and discharge the air. With the air pressure at 60 pounds per square inch, as is common in machine shops, an 8-inch cylinder gives a dead pressure of 3,000 pounds; but the action of this press should be, and is quick and sharp; therefore the actual pressure is away above 3,000 pounds; two or three sharp blows will form an 8-inch cup long before a hydraulic press has started on its journey. Taken altogether this press is a pretty good thing for this work if properly made, *i. e.*, good and heavy. The rods *D* should be not less than 1½ inches diameter, the threads should not be ended

sharply nor loosely fitted to the nuts. The nuts should have some style of lock fitted to them—cotters, for instance—otherwise the constant pounding will loosen them. I believe it unnecessary to use any kind of piston packing or even a stuffing box. It will make twenty or twenty-five 5-inch strokes per minutes if the valves are large enough, and evidently it should be well fastened to a solid bench.

Larger packings were formed on a 24-inch press of the same order also run by air. With 60 pounds of air we get a pressure of 14 tons, and that was sufficient for our largest packings, 24 inches, although a few 30-inch cups were formed once in a while. For ordinary work like this, I prefer air to water, it being far cleaner and more feasible, though for high pressures, of course, nothing can equal water. WM. H. BROOKS.

The Bonus System of Rewarding Labor—Grinding Twist Drills.

Editor American Machinist:

Your contributor, D. Addie, whose letter you publish at page 164, is evidently slightly mixed in his understanding of my criticism of the "bonus system." He refers to the system from first to last as the "premium system," which it is not.

As to the feeling in the shop being understood in the office, to discuss it is a waste of time and space. We who have been there know and those who have not cannot understand.

D. Addie says: "As a matter of fact, Dame Rumor says the *premium system* at the Bethlehem works acts as a drawing card to the best and brainiest mechanics," etc. Mr. Taylor says: "A good foreman is almost impossible to get" and he states this to have been one of his chief embarrassments.

This leaves it between Mr. Taylor and Dame Rumor, or leaves us to infer that brainy mechanics do not make good foremen, and excludes any possibility that D. Addie is utilizing his chapeau as a megaphone. It certainly was not my purpose to find fault with the suggestion box. The idea is good. My kick was aimed at the method of carrying it out. I will not go into the suggestion box question, as it is a long story. The AMERICAN MACHINIST, page 97, February 4, 1897, has a description and illustrations of nearly the form of twist drill grinding to which I referred. In this case the drill was not ground away at the back. The angle of clearance was constant from point to outside of lip. If D. Addie ever uses drills and happens some day to strike a hard piece of steel that a drill ground "theoretically correct" will not go through this may help him. W. A. WARMAN.

Lubrication and Education.

Editor American Machinist:

There are some queer things about the history of the use of lubricants in connection with running machinery. The queerest thing of all, probably, is in the slowness with which we have reached a realization of the importance and necessity of it. We have perhaps attained at last to something like a correct appreciation of the function of the lubricant in mechanical operations, but we have been a long time getting there. It is very clearly our own fault, too. We had sufficient and insistent evidence of the constant and universal presence of lubricants in the animal world from the beginning. None could have failed to note the perfect lubrication of the ball and socket joints of the limbs of freshly killed animals, or of all their surfaces, hard or soft, where any sliding action occurred, and the lubricant distributed over the entire exterior of the fish, so that it might glide frictionless through the water, was an object lesson to the first of the human race. We have not even yet found the way to get rid of, or even to reduce, the skin resistance of our ships, and this most likely because we have been so slow in recognizing the imperative necessity of doing so; but some of the more primary lessons in lubrication we have learned with more or less thoroughness.

We have learned, most of us, that the lubricant is not to be an incidental and occasional expedient, but should be a constant and universal and necessary component of every series or train of mechanism. The lubricant is to be assumed as belonging to and a part of each of "the mechanical powers" in detail, and so in any combination or application of them; and yet probably in the beginning when a wheel was made to turn upon an axle the lubricant was not at all thought of, just as a child would not think of it to-day. Long experience and great annoyance, and wear and derangement and anxiety, brought the knowledge that oil would stop squeaks and reduce wear, and incidentally make things run easier, and so the oil can came into use. The rule of the hand oil can lasted long. The application of lubricants by it was intermittent instead of continuous, and generally on the insistent demand of the abrading surfaces; and until provision began to be made for continuous lubrication the lesson was not more than half learned. It is an encouraging sign of progress that the hand oil can has now so little to do about the modern steam engine.

Probably the necessity of oiling or greasing a screw, especially if it is in frequent or continuous use, is as completely recognized as any application of a lubricant, and for inclined planes and wedges in general, when distinctly recognized as such, the mechanic of to-day would not be apt to forget the oil or the grease; but what about our cutting tools? They are wedges the most numerously used of all, and subject to the severest duty, and yet only very recently have we got into the way of lubricating them. Now that we are doing it so generally, and are realizing the advantage of it, we are still hardly willing to give all the credit to the lubricant, and some exploiters of special brands or treatments of steel are claiming part of the good results that really belong to the lubricants employed.

I suppose it may be said generally that the function of the lubricant was never before so highly appreciated as now, that the best mechanics are foremost in the appreciation and that this has been an important factor in the success of modern machine and engineering practice. There is of course, but not among good mechanics, some lingering of the old and once very general impression that the lubricant is after all a concession to some defect or imperfection in mechanical devices, and that it is, although necessary, still a necessary evil, and there is a disposition to "economize," as they call the operation, as much as possible in this particular direction. The railroad papers into which I peep occasionally, are complaining of this tendency among high-up railroad officials. They are disposed to get along with as little lubrication as possible, and to take pride in small oil bills, even if the coal bills go up.

Some who may have noted the title of this letter may be wondering what lubrication has to do with education, and this brings us right to it. I am not suggesting at all that the function of education in connection with the mental mechanism is strictly analogous to that of the lubricant and the machine, still they are both now in some respects similarly regarded as more or less suggestive of waste and extravagance. While some are still trying to see how little oil we can get along with some others are figuring how little education will suffice, and then of course what is more than sufficient should be cut off. It seems to me that while upon the whole we have distinctly advanced in the matter of lubrication, we have just as distinctly retrograded, and are now retrograding in the matter of general education.

We have come to where we are by what we pride ourselves is the "practical" route. The idea now is to educate the individual for the position that he is to hold in life, and then to cut off as worse than worthless what we may judge to be unrelated. Some are practically saying to-day: Let the education of the man of the shop be such as will be of use to him in the shop, and let it go little beyond that. There are those who are asking what he has to do with general literature or the vast wealth of scientific lore which only remotely, if at all, touches the shop. What business has the man at the lathe with history or poetry or political economy or descriptions of peoples and places in the remote corners of the earth?

Answers to some of these questions come easily to us when we remember that men work in the shop only one-third of their breathing hours in the middle years of their lives; and they work that third mostly for what promise there may be of

pleasure or satisfaction to be extracted from the other waking hours. What will make life on the whole more worth the living is the thing to be kept in mind by mechanics who think and plan about their education, and by those who assume to plan for them. Educate the whole man, and only then do you obtain the best equipped, the most alert, the most productive, the most reliable and progressive mechanic. Those who have to do with the boys that come into the shops invariably tell me—what I don't need to be told—that the best material for workmen is found in the boys who have been the best all-around scholars in the public schools.

TECUMSEH SWIFT.

A Convention of Machinery Builders in Russia.

The Russian builders of machinery seem to have been making an attempt to establish a "community of interests" that is somewhat novel in its plan and scope, the aim being apparently to completely eliminate competition for business yet not by means of an actual combination of interests. The following account of it reaches us from Russia:

"The convention of machine builders of Russia, which met at Kharkof on January 21 (February 3) of this year, adopted a resolution to form a union of all machine-building works in Russia 'with the purpose of regulating prices and conditions on which the orders for machines may be carried out.' It is projected to divide all the works into eighteen groups according to the kind of machines they produce. The basis on which each group enters into the union is to be worked out by the head of each group. The orders to be justly divided between all the works of the union according to their capacity. The committee on machine building has presented to the convention a résumé of the work of five sub-committees. The report of the committee, read by Mr. Kannegisser, concludes with series of *desiderata*, which are to be presented in the form of a petition to the government. They were adopted by the convention. The principal *desiderata* are: 1. The revision of the tariff concerning machines, this revision to be made with the aid of specialists. 2. The introduction of the more detailed tariffication. 3. Strict application of the Imperial *ukaz* (order) to give all government orders for machines to Russian works. 4. Large credit to machine builders warranted by raw materials and unfinished product. 5. Specialization of factories. 6. Institution of the Bureau of Statistics. It was also highly recommended by the committee to create a bureau where all the orders for machines might be concentrated. The convention has also adopted following important petitions of the government, viz., equalization of duty on locomobiles and on all agricultural machines with the exception of those which as yet are not manufactured in Russia.

"These resolutions of the Kharkof Convention do not, however, receive the general approval. The *Novoye Vremia*, the most read paper in Russia, in the editorial of to-day, January 22 (February 4) prints the following remark: 'One more syndicate is ready to be born, and as a matter of course it cannot be welcomed by the users, including among them the government. The nature of this projected organization is very simple: it aims to place the user in such a position that he might be forced to accept such prices, goods, and in general all the conditions that will be proposed by the syndicate. But what will become of this syndicate if the largest of all the users in Russia, the government (railroads, etc.) will resolve that all government orders will have to go only to those works which do not take part in the syndicate? Who of the two parties will be then the master of the situation? In general it must be remembered that 'trusts' are possible in Russia only, inasmuch as they are tolerated by the government, which is the colossal user."

Such an arrangement, if it were to be successful, would probably have a very profound effect upon the Russian machinery trade and upon Russia generally. It would hamper imports of machinery and would undoubtedly very much retard the industrial development of that country.

The National Civic Federation.

The first regular meeting of the executive committee of the National Civic Federation was held in this city, February 19. Twenty-eight of the thirty-six members of the committee were present and Senator Mark Hanna presided. A set of by-laws for the guidance of the organization were adopted. The preamble sets forth the purposes of the federation as follows:

"The scope and province of this department shall be to do what may seem best to promote industrial peace and prosperity; to be helpful in establishing rightful relations between employers and workers; by its good offices to endeavor to obviate and prevent strikes and lockouts, and to aid in renewing industrial relations where a rupture has occurred.

"That at all times representatives of employers and workers, organized or unorganized, should confer for the adjustment of differences or disputes before an acute stage is reached and thus avoid or minimize the number of strikes or lockouts.

"That mutual agreements as to conditions under which labor shall be performed should be encouraged, and that when agreements are made the terms thereof should be faithfully adhered to, both in letter and spirit, by both parties.

"This department, either as a whole or through a sub-committee by it appointed, shall, when requested, act as a forum to adjust and decide upon questions at issue between workers and their employers, provided, in its opinion, the subject is one of sufficient importance.

"This department will not consider abstract industrial problems.

"This department assumes no powers of arbitration unless such powers be conferred by both parties to a dispute."

The by-laws go into all the details necessary for a perfect working organization, which it is not necessary here to repeat. There is to be an executive committee consisting of twelve representing employers, twelve employees, and twelve the general public, with the usual officers whose duties are prescribed. The chairman is to appoint a committee on conciliation, taking three from each group, whose duty it shall be in case of a threatened strike or lockout of more than local magnitude, to use its good endeavors to restore harmonious relations.

As to arbitration and emergencies the laws provide:

"Arbitration.—Should the efforts of the conciliation committee prove ineffective, and should both parties to the dispute desire the services of the executive committee of this department, they may be invited to select two employers and two wage earners from said executive committee to serve as an arbitration board. Should the four find it necessary to appoint an umpire to finally decide the dispute, they may select a fifth member from the group representing the public.

"Emergencies.—Should a controversy seem of such magnitude as to justify such action, the officers shall be authorized to call a meeting of the entire executive committee to consider the situation and take such action as may in their judgment be required."

The executive committee, it is further provided, may appoint auxiliary committees to deal with local disturbances and shall have power to fill all vacancies.

Making Strenuous Workmen Junior Partners — Appreciation of Long and Faithful Service.

Sixty-two employees of the United States Steel Corporation were called into the offices of the mills at Homestead, Braddock and Duquesne, recently, and presented with certificates of stock as a reward for faithful services performed. The stock was given outright and can be disposed of or retained at the pleasure of the recipient. It is dividend paying and all the men benefited have declare their intention of holding it. The amounts given to different men vary from $1,000 to $50,000, according to the importance of their positions.

It is interesting to note the various offices held by the beneficiaries, which range from labor-gang foremen to superintendents and include chief clerks, chemist, master mechanics, chief inspectors, time keepers, paymasters, chief shipper, painter, several old rolling-mill hands, about twenty assistant superintendents, and as many

more superintendents of the various departments, as the armor plate, steel rail, Bessemer bar, transportation, construction, etc.

The fund through which the men secured their stock was originated by Andrew Carnegie and his partners some years ago. The general superintendents and other high officials received stock at that time, but it was not until the United States Steel Corporation was organized that it was decided to make the heads of all departments junior partners in the company.

The custodians of the fund are Messrs. Carnegie, Schwab and Thos. Morrison, the last named being general manager of the Edgar Thompson mills.

Mr. Carnegie held 62 per cent. of the stock when the steel combine absorption took place, and his contribution of 2 per cent. is said to have totaled up to between $4,000,000 and $5,000,000.

The other partners are all contributors, with the exception of Messrs. Frick, Moreland, Phipps and Lovejoy, who declined to contribute to the fund, and are reported to have taken $1,500,000 from it in March of last year, when they withdrew their portions of 2 per cent. of their holdings. There is still a very large amount to be distributed and many other minor foremen and officials will be taken in to share the profits.

The plan for pensioning old and deserving employees of the mills, for which Andrew Carnegie donated the sum of $3,000,000 a year ago, will soon be put in operation and hundreds of the old employees will be "laid off" on the pension roll. The general plan as now outlined by the trustees of the fund is to give a certain percentage of a man's pay at the rate he received at his time of retirement.

The disability fund is an old custom and has been of great benefit to the families of the steel workers who have been injured or killed by accident while on duty.

The Westinghouse Electric & Manufacturing Company, at their East Pittsburgh plant, have adopted a plan of extra compensation to the heads of shop departments, foremen, general foremen, assistant superintendents and superintendents, which also offers an incentive to further efforts by the men involved.

The arrangement is a premium or bonus divided into grades of which the first pays 12 per cent. of the salary in addition thereto, the second pays 9 per cent. and the third 6 per cent. As an example, the foreman who receives a salary of $125 per month would get (if in the first grade) 12 per cent., or $15.00 extra per month.

The first grade embodies the men who have given the longest continued service to the company or results from some special efforts exerted. As but few are as yet included in the higher grade, there is a natural inclination on the part of all in the two lower grades to show some results which may entitle them to the higher rate. The premiums are paid every three months, and while coming somewhat in the nature of a gift, they materially increase a man's capacity by stimulating him to attain a higher degree of efficiency as well as by placing him in closer touch with the company's intersts.

PITTSBURG.

A Severe Arraignment.

In a recent issue of the *Railroad Gazette* a correspondent discussing the latest tunnel horror thus characterizes the organization of the company:

"Comparisons are frequently odious, and in the following comparison it is its value that makes it odious. On the Pennsylvania Railroad, the president and two of the vice-presidents are trained engineers, as is also the general manager and four out of five of the general superintendents, and most of the twenty division superintendents. Of the small minority of the general officers who are not technically civil or mechanical engineers, a considerable proportion have had training in those departments. The result of this full knowledge by all heads of departments of the company's physical properties and of the laws which govern the forces of nature is shown in the permanency of its works, the quality of its service, and the serious earnestness of purpose and loyalty of the members of its staff.

"On the New York Central the scientific man does not belong. Not a member of its board of directors, not a general officer, except of the engineering departments, is an engineer, and surprisingly few among them are educated men. It may be in some specific cases unjust to say what is generally true of those in control of the operation of this great, this delicate and complicated transportation machine—their positions are valued for their power and for their money return only. There is no pride in accomplishment, no zeal, loyalty, or hope for advancement by merit. The few earnest, scientific men have no support and are surrounded by an atmosphere of guessing. The spirit of a corporation starts at the top and reaches to the gravel train crew. Headquarters' clerks and private secretaries are whimsically put in control of structures and machines of which they know little more than the names and purposes; the deadly accidents occur; the directors cower and flinch before public execration until the storm blows past and they can again give serious attention to funding operations, new issues, and the defense of damage suits.

"It is easy to criticise. If this criticism is in any respect unfair the writer is sincerely sorry for it. The directors have not been niggardly; rather, their expenditures have been lavish, but they are responsible for the undeniable ignorance of the officers in charge of conduct of transportation, which is the real cause of the disasters that have occurred and of the continuing dangers and certain accidents and losses which will surely come so long as childish pride in speed records, enjoyment of power and greed are the impulses substituted for respect for knowledge and pride in good work."

Liquid Fuel in the Navy.

The Secretary of the Navy has transmitted to Congress, to be included in the naval appropriation bill, a supplementary estimate of an appropriation amounting to $20,000, for the purpose of investigating the best means of burning liquid fuel for naval purposes. Accompanying the estimate is an urgent request from Rear Admiral Melville, of the Bureau of Steam Engineering, for granting the appropriation. Admiral Melville points out that in view of the fact that there now appears to be an unlimited quantity of crude petroleum both in the California and Texas oil fields, which can be delivered at tidewater at a comparatively slight cost, the Bureau of Steam Engineering believes that there is necessity to commence extended experiments for determining how this combustible can be adapted for naval purposes. In the annual report of Admiral Melville he stated that the problem of utilizing liquid fuel for naval and maritime purposes was one that it was the duty of the navy to help solve. The Bureau has been urged by many interested in naval affairs to make the request for the appropriation, since it is believed that the present is an opportune time to take up the subject again.

It is intended to make the Louisiana Purchase Exposition at St. Louis twice as large as the Columbian Exposition at Chicago, not only in extent of buildings and grounds, but in its exhibits and other features. Provision has been made in the 1,200 acres comprised in the Exposition area for more than 200 acres of floor space. Nearly $1,000,000 worth of buildings—the Washington University group—are in process of construction, some of them about finished. The construction of one of the largest of exhibit buildings is about to begin and will be completed October 1. Other contracts will provide for the completion of all important buildings this year. The total cost of the Exposition is estimated at $30,000,000 to $40,000,000, of which more than $20,000,000 is now in sight without further effort on the part of the Exposition authorities and without any bond issue by the Exposition. Every country of the world will be represented at the Exposition, nearly all of them officially.

The "Monthly Summary of Commerce and Finance," covering December returns, published by the Bureau of Statistics, Treasury Department, Washington, D. C., contains a study upon the great canals of the world.

The Opinions of Machinery Manufacturers on Reciprocity and Foreign Trade—III.

Below we continue the publication of letters from manufacturers expressing their opinions on matters connected with foreign trade, written in reply to our circular letter of inquiry printed at page 242:

The Faneuil Watch Tool Company, manufacturers of watchmakers' lathes, etc., Brighton, Boston, Mass., say:

"We consider that free trade is the proper condition to obtain between our own and other countries; although if the protective tariffs had to be taken off all at once it would paralyze business altogether, but we think that some arrangement could be made whereby a certain amount (say, 5 per cent. at the most) could be taken off each year, so that at the expiration of a certain time we should have free trade. This would enable the manufacturers in this country to make their plans accordingly.

"As the tendency has been to higher wages in the European countries during the past few years, this we think would tend to equalize things so that the abolishment of protective tariffs in a few years would not make so great a difference to our domestic manufacturers who now need protection as it would do were they to be taken off at the present time.

"As to your particular questions, we would say that we do at the present time need a protective tariff in our business.

"We do think that the present high tariff has a tendency to retard foreign trade to some extent.

"Free raw materials would not allow us to produce our tools any cheaper than at the present time.

"We think that ordinarily free raw materials would tend to keep the prices on such materials more uniform.

"So far as we know, workmen in all the European countries do more for a dollar in pay than they do in the United States.

"Even at the present rate of tariff our tools are taken to Europe and imitation copies made of them which are sent back to this country and sold for less than we can make them. In this way the business in our watchmakers' tools has been completely undermined."

Norman H. Fay, writing for Fay & Scott, manufacturers of machine tools and dealers in machinery, Dexter, Maine, says:

"I agree in the main with the words quoted from the late President McKinley's speech, though I think this particular quotation could be given a meaning contrary to my belief.

"Secondly, I do not think we need a protective tariff in our particular business, and I do not think the present tariff retards export trade.

"I believe that if foreign people want our goods they will buy them without regard to whether they are selling to us or not, especially in view of the fact that it is not usually the same individuals that are offering or expect to sell us goods that are buying of us.

"Free raw material would make but little difference in our business.

"There are doubtless some lines of goods in which free raw material would be conducive to more uniform prices.

"In regard to foreign workmen. I cannot speak from actual knowledge, but it is quite evident that there are many countries where the workmen put in more hours for a dollar than in the United States, but it is a question whether they do as much work or not."

Flather & Co., manufacturers of machine tools, Nashua, N. H., say:

"We have for some time been of the opinion that to hold the European trade something should be done, either by reciprocity or lower tariff, to meet the feeling in foreign countries that if we are to sell in their markets they should have more privileges in the United States.

"We fully agree with the words spoken by the late President McKinley in his address in Buffalo.

"We do not think the present high tariff is needed on machine tools, and we also think the high tariff has a tendency to retard foreign trade.

"In our opinion it would be a great advantage to the machinery manufacturers in the United States to have free raw materials. It would enable us to produce goods cheaper and also would have a tendency to keep the price of materials more uniform.

"As to the inquiry, 'Do you know of any country where the workmen do more for a dollar than they do in the United States?' we think that generally they do not, but we have been in some establishments in England and Germany where by comparing rate of wages paid and the output we think they do.

"We are of the opinion that where we have the advantage in the United States is that the shops here run to specialties and do not try to build everything, and also that there are less non-producers in proportion to the producers."

The Fosdick & Holloway Machine Tool Company, manufacturers of radial and upright drills, Cincinnati, Ohio, say:

"As builders of machine tools we cannot see any necessity for a protective tariff for these particular articles, and in our opinion the present high tariff certainly does not have a tendency to help the machine tool trade abroad. We think if the United States would reduce the duties on many articles that we import the foreign countries would certainly have a kindlier feeling toward us and feel more like buying American machinery. While the rate of wages paid to the American mechanic is much higher than in any foreign country, we consider that he does as much more work for the additional compensation that he receives."

The Garvin Machine Company, manufacturers of and dealers in machinery, Spring and Varick streets, New York, say:

"We believe these to be such comprehensive and far-reaching subjects that laymen should confine them to the statesmen, diplomats and economists for a solution.

"While we might be able to give such as may authoritatively consider this subject facts regarding our knowledge of foreign trade that is not important at this time, but we do hope that great care, conscientious and thorough investigation be given the subjects by our national legislators before conclusive action, lest industries already established be hampered or crippled; and further, that in the endeavor of the government to inaugurate reciprocal treaties it may not alienate more than it makes industrial friends. Further, above all we hope that when the subject is under serious consideration the fact will not be lost sight of that it is essential—and absolutely a necessity—if we expect to retain as a nation continued prosperity that the balance of trade shall be maintained in our favor."

The Gisholt Machine Company, manufacturers of turret lathes, Madison, Wis., say:

"We heartily agree with the words of the late President McKinley at Buffalo as expressed in your quotation.

"It seems to us that reciprocity agreements should be entered into as fast as conditions will permit. In our estimation machine tools are now so fully developed that a protective tariff is unnecessary; still, it might be unwise to remove all of the duty at one time. The present high tariff, in some cases, probably tends to restrict free trade, at least indirectly, but special agreements might be made which would minimize this difficulty. We believe that free raw material, on the whole, would not enable us to produce more cheaply; nor do we think that it would tend toward keeping prices more uniform. England has free raw material, still there has been considerable fluctuations in prices on account of the outside competition. Our opinion is that, as a rule, American workmen produce more work for a given sum than the workmen of other countries, although the writer believes that in some lines in certain localities in Europe the rate of pay is so low that the workmen actually produce more than here for a given amount in wages."

The Gleason Tool Company, manufacturers of gear, planers and gears, Rochester, N. Y., say:

"We are in favor of a reduction in the tariff on machinery to 10 or 15 per cent. The reason is that though we have been able to sell a great many of our special machines in Europe during the last eight years without hurting our scale of wages, we have been able to buy but a very few because of our prohibitory tariff.

"There are several valuable machines we want that are made in Europe but that are not on the market in this country, and some of them are made by the very firms who have bought our machines. It does not seem square to them that we cannot give them our orders, to say nothing of the loss to our business through the lack of these valuable tools. If the other side improve on the quantity and quality of their output per man faster than we do, it will be as easy to put the protective tariff on again as it is to take it off."

The Goodell-Pratt Company, manufacturers of mechanics' tools, Greenfield, Mass., say:

"We hardly feel capable of going into any long discussion of this subject; personal views and prejudices are no small factor in the deducing of and arriving at tariff opinions. Whereas possibly the last few years has made something of a change in the general trend, there are many who at the present time will hold to their former extreme views.

"As far as our business is concerned, we need no protection. We can go into the markets of the world and compete, not always in price, but every time on quality. A reduction of the present tariff upon raw materials would help us, and we believe would stimulate a good feeling among other countries which would more than make up for what little trade might possibly be affected here."

John J. Grant, writing for the Grant Tool Company, manufacturers of machine tools, steel balls, etc., Franklin, Pa., says:

"We do not believe we need a protective tariff in the manufacture of machine tools. The writer's long experience over there in selling tools abroad leads him to believe we can and do undersell a fairly made machine tool that is made in any foreign country. Certainly there are very few machine tools made across the water which we would care to use in this business on this side. Understand me, there are many good tools made over there, but I believe we have paid more attention to our machine tool design and construction than they have and we certainly ourselves would not care a rap if the tariff was taken off at once.

"In regard to the material used in the manufacture of our tools, would say that it might help us some if the tariff were removed, as it would cause a little competition and reduce the prices of raw material, although we are not so sure about that."

The G. A. Gray Company, manufacturers of machine tools, Cincinnati, Ohio, say:

"We really have no very decided convictions in the matter, except that we feel it would be very unwise to do anything now which would start a tariff agitation in Congress and thereby possibly unsettle business. Mr. McKinley's words in his Buffalo speech were wise and well chosen, but we do not believe that he intended them to have any influence toward bringing the question of 'tariff tinkering' into Congress."

Franklin Hardinge, of Hardinge Bros., manufacturers of special tools for watchmakers and all kinds of fine metal working, 1036 Lincoln avenue, Chicago, says:

"I agree with our late President. I have always believed that his experience was worthy of great respect and no doubt he was well informed in practical politics. Mr. McKinley's opinion has more than stood the test of practical application and the words referred to are well worth anyone's thought.

"The first thing is to keep our people employed and at good wages, but it is better they be employed at small wages than not at all. Many causes may make men idle here or there, but when lack of employment becomes national it is caused by the lack of purchasing ability of the masses, as very few have the good things of life which they desire, and with this fact in view there should be no idleness until everyone has been amply provided for. As to our producing ability, there is no question; therefore, the fault must lie in our distribution, and I consider it the first duty of our law makers to remedy this defect. It is better that we do not trade at all if we cannot profit thereby. Can we keep our people employed and at the same time allow our people to purchase two or three days' labor from other countries for the same price they must pay for one here, which is the case with plenty of goods in the line I am engaged in manufacturing? Can I sell to these countries at a profit or at all while the difference exists in the value of a day's labor, which is now the case? If this condition can be done away with (which can only be done by increasing the value of the European mechanic's labor) then I can see some hope of a reduction in the tariff, but at present it simply means to our workmen less pay or get out of business. This applies to manufacturing watchmakers' tools, and I see no reason why it will not apply to any manufacturing where the labor constitutes the principal cost and not the material. In other industries where materials are the larger cost, it may be different, yet I can see no reason why the labor difference will not apply to almost everything, and in such instances as we are able to sell in Europe it must be solely due to our more extensive plants, machinery and management and the conditions in Europe being more favorable to certain lines. Not doubting the fact that we must eventually even up the labor difference and extend our trading, I believe the first step is transportation, so that people can come and go, and by taking and giving we will become more like one people; then we will trade more freely, as the natural resources of each country will be the leading articles of trade. We must not forget, however, that the people must be allowed to get at those natural resources and not be held off by legal fences and be made to sit idly by while the so-called trade depression gets the blame.

"Regarding the present high tariff retarding trade, I believe it has a tendency to make the workmen of Europe worse off than with a low tariff or no tariff at all, but as a man's home should be looked after first, and not being able to control the affairs in Europe, we must look after that which we can control and a high tariff does not necessarily prevent us from exporting only to the extent that it raises wages here, and if that raise is the profit in Europe the consumption here is increased proportionately, so it evens up and we are no worse off.

"As to raw materials, it must all depend upon their nature. Such raw materials as this country is incapable of producing should certainly come in free.

"The only way a man can perform a good day's labor is by being well clothed and housed, and the more comfortable a manufacturer makes the laborer the more liable he is to get a larger percentage of labor performed. Generations of well-fed people must develop more keen intellects and the more downtrodden any people become the more their offspring will put up with. I am for the uplifting of the worker in body and mind, but we cannot allow hunger to be felt or the honest workman to seek employment in vain, and in order to do this America must prevent land monopoly: then her workmen will be capable of producing a day's labor to the extent that they are employed at good wages and be able to enjoy life as their labor entitles them. I believe land monopoly in foreign countries to be directly responsible for the subdued worker. I say 'subdued,' judging how a man must be situated when he will perform the amount of labor he does for the small compensation which he must receive judging from his product, and when the people of other countries are even as free and independent as our people we should have free trade and raise our revenue by direct taxation."

The Ingersoll Milling Machine Company, manufacturers of milling machines, Rockford, Ill., say:

"We firmly believe that this country needs an outlet for its manufactured goods and that our trade with foreign countries

must be continued or we will feel the effect of it very severely. We wish that we had the ability to express more fully our views in this matter."

W. L. Saunders, writing for the Ingersoll-Sergeant Drill Company, manufacturers of air compressors, rock drills, coal cutters, stone channeling machines, etc., 26 Cortlandt street, New York, says:

"The extract from the Buffalo speech of President McKinley which you quote and ask us to criticise has appealed to us as a wise statement inspired by a spirit of foresight and justice, and made in the interests of American manufacturers. President McKinley was always the business man's President.

"It is just as important now to protect our manufacturers by securing and maintaining open markets for their surplus products as it was ten years ago to protect them in the home market against foreign competition. Europe then wanted us, we now want Europe.

"All commerce to be permanent should be reciprocative. We cannot always sell unless we also buy.

"We would follow the advice of President McKinley by using such of our tariffs as are no longer needed for protection or revenue for the purpose of increasing our trade abroad. This means tariff revision of a kind and in a way that could not produce a business collapse but which would pave the way for greater and continued prosperity. It was a serious matter to tinker with the tariff when Europe wanted us for a market and was held back only by the bars of protection. Even five years ago there was a scramble for American trade by foreign merchants, and a desire to get in here, while now conditions have changed and we are standing at the gates of foreign nations with products better and cheaper than theirs seeking their markets. The men who once wanted to sell us their goods are now ready to buy ours. In such a condition of things as this, why should we apprehend any danger from tariff tinkering on the McKinley basis? Does anyone believe that a reduction of 50 per cent. on iron and steel products would produce even a ripple of disturbance to our business? The alarm about the tariff is an inheritance which became rooted at a time when conditions were almost directly the reverse of what they are to-day. Professional politicians and professional protectionists are the alarmists who control the situation to-day at Washington.

"The people will not long sustain a condition which cannot logically and fairly be justified. If trusts and combinations are to remain permanently as a part of our industrial system, they must be conducted in the interests of the whole people. The most vulnerable thing about a trust is where it can be shown that legislation has been called to the support of the trust to aid it in stifling competition. We cannot reasonably justify a protective tariff on a trust-made product. At the time the Dingley tariff bill was passed there were few of our industries controlled by trusts. To-day there are but few of the large manufacturing industries that are not controled by trusts. Where there is internal competition the people are protected against monopoly profits, but in a trust-made product the importing point alone limits the price. As present prices in some trust-made products are close to the importing point, it follows that the tariff is a means by which monopoly profits are secured. Such a tariff is a tax upon one class of people for the benefit of another and as such it violates the Constitution of the United States.

"What we want is markets, not protection. We build by machinery and our productive capacity is so great that the world's market is needed to maintain its stability. It is better to provide markets for our surplus than to curtail our product and discharge our workmen. The more we build of the same thing the greater profit do we make, and at a lower cost of production. This is one of the reasons for our present prosperity. Mechanical appliances that lower cost are made possible only by a large output. Our productive capacity per man employed is made greater by machines, and in order to employ all of our labor and at good wages we must enlarge our markets. At one time in the Carnegie works 800 men were employed in a department that produced 1,200 tons of steel. By the use of improved machinery 1,500 tons were produced by 65 men. According to Labor Commissioner Wright, an American firm hand raises as much grain as three in England, four in France, and five in Germany.

"A protective tariff does not benefit the mining-machinery trade. Few in this business know what the duties are on our products, and if they were taken off entirely no harm could result, because American made mining machinery is better and cheaper than any other. The tariff acts only to increase the cost of our product by increasing the cost of raw materials. It puts an obstacle in our way when we go out to develop foreign business, as we are met by retaliatory duties, by criticism of our prices, which we are told are upheld by high tariff laws, and by the stigma of unpopularity which follows the product of a country which maintains the bars of protection against its neighbors, and at the same time seeks business abroad.

"Protection is not a shibboleth—not a religion. It is a practical means to an end; a temporary policy to be followed until its object has been attained. It is based on grounds of expediency, and a lower tariff is advocated on similar grounds. Protection means exclusiveness at home at a sacrifice of foreign trade. It is a course of training for that industrial and financial battle for the world's supremacy which it is our determination to win.

"To argue that we should 'let well enough alone' begs the question. What is well enough to-day may not be well enough to-morrow if conditions change. That conditions governing trade and commerce in the United States have changed in the past five years, who will deny? We are dealing with a great business question, and the business man who does not shape his policy to meet situations will fall behind in the race. A wiser motto than 'let well enough alone' is one which has been handed down to us as a truth from Holy Writ: 'Let him that thinketh he standeth take heed lest he fall.'"

Report of the Commissioner of Patents.

The report of the Commissioner of Patents recently submitted to Congress is interesting as showing that the business of the Patent Office for the year ending December 31, 1901, was the greatest in its history. The receipts for the year amounted to $1,449,398, while the expenditures were $1,297,385, leaving a surplus for the year of $152,013. Another interesting fact shown in the report is that the balance in the Treasury to the credit of the office is now $3,329,471. Just 52,912 applications for patents were filed and 27,373 patents issued, being the largest annual issue in the entire history of the Office. The total number of trade marks, prints and labels registered during the year was 2,965, the largest yearly issue of certificates of registration. The report also shows that the office has been making money for the government since 1836, and it would seem that the inventors of the country were entitled to some little consideration at the hands of Congress, but notwithstanding the enormous sum to the credit of the Patent Office which has been contributed by our inventors Congress will not appropriate sufficient money to properly carry on the work of the Office, which is now several months behind. Such a condition of affairs works to the hardship of American inventors. Every commissioner pleads for larger appropriations to enable him to handle the increasing business of the Office with greater facility. A. F. TENNILLE.

It is stated in Boston that boilermakers employed in the railroad shops of that city and vicinity will ask for a nine-hour day without lowering of wages. Boilermakers have had a nine-hour day in the shipyards and shops owned and operated by private owners or contractors. Boilermakers' and Iron Shipbuilders' unions 9 and 250 have appointed committees to take the matter up. The men now receive from $2.50 to $3.50 for a working day of ten hours.

AMERICAN MACHINIST

Published at 218 William St., New York, every Thursday by the

American Machinist Press.

[INCORPORATED.]

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

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Francis A. Pratt.

Francis Ashbury Pratt, whose death we announced last week, was born at Woodstock, Vt., February 15, 1827, so that if he had lived five days longer he would have completed his seventy-fifth year. He was a direct descendant of early English settlers of New England. His father, Nathaniel M. Pratt, was a leather dealer at Reading, Vt., and when the son was eight years old he changed his residence to Lowell, Mass., where the boy enjoyed the usual school facilities and at as early an age as possible was apprenticed to Warren Aldrich to learn the machinist's trade. In 1848, then twenty-one years old, Mr. Pratt entered the employ of the Gloucester (Mass.) Machine Works, where he soon became a contractor. Four years later he was busy in the Colt pistol works at Hartford. It was here that he was first associated with Amos Whitney, who for all the rest of his life was his most intimate business associate. After about two years both of the young men left the Colt works, Mr. Pratt becoming superintendent of the Phœnix Iron Works, of Hartford, Mr. Whitney assuming a responsible position with the same concern. In 1860 the firm of Pratt & Whitney began business in a very small way, some of their first work being for the Willimantic Linen Company. They were burned out before they had been in business a year, but started again immediately in another location, and in 1862 Monroe Stannard, still living, was taken in as an equal partner, the combined cash capital being $3,600. In 1865 the firm erected the first of the series of buildings which now constitute the plant of the Pratt & Whitney Company. The company was incorporated in 1869 with a capital of $350,000, which was afterward increased to $500,000 from the earnings, Mr. Pratt becoming the president of the company and Mr. Whitney the general superintendent of the works. In 1893 the company was reorganized with a capital of $3,000,000. In 1898 Mr. Whitney became president and Mr. Pratt was made consulting engineer, a position which he held for but a short time, and for the last two years he may be said to have been absolutely retired from active business.

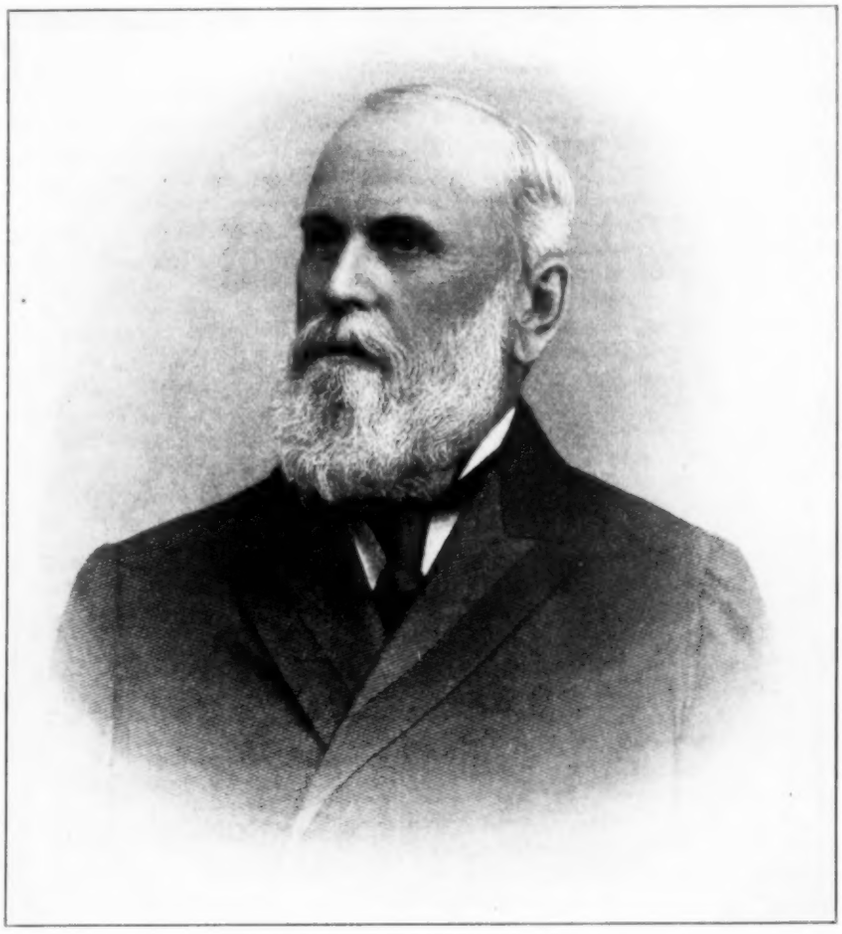
Mr. Pratt was from the outset a leading spirit in the development of the great establishment, not only as a mechanician but also as a business man. The firm at once became a leader and teacher of the mechanics of the world. It became at once a suggester of new methods of work and a provider of new means for its accomplishment. Machine, gun and sewing machine tools have been turned out by this firm in unusual variety and possessing great originality and efficiency. The firm early developed an extensive foreign business to which Mr. Pratt paid special attention, having made ten trips to Europe for the purpose. In 1890 he was appointed by the Secretary of the Treasury of the United States a member of the commission for the examination of treasury vaults, his associates being Theodore N. Ely, superintendent of motive power of the Pennsylvania Railroad, and Dr. R. H. Thurston, of Cornell University. Mr. Pratt was a charter member of the American Society of Mechanical Engineers and had been a vice-president and a manager of that organization.

We now speak in greater detail of one specific portion of Mr. Pratt's lifework relating to the early development of the interchangeable system of manufacture. The first substantial beginnings of this system were made at the Springfield Armory about 1840 by Thos. Warner, then master armorer. The work was done chiefly by hand, but the parts, instead of being fitted to each other, were fitted to master pieces or templets. Large use was made of filing jigs, by which was done much of the work for which milling and profiling machines would now be used. The methods now seem crude, but they inaugurated a new mechanical era. The system was fairly well developed on these lines before the outbreak of the War of the Rebellion, and it is a fact of historical interest and importance that the first mechanical product to be made by this method on a large scale was the small arms supplied to the Northern armies of the Civil War. This was a natural line of development. Machinery had not then entered into the life of the people on a sufficient scale to call for highly developed methods in its manufacture. Few mechanical products were consumed in large numbers. Guns, however, in case of war, were an exception, and armories were among the largest existing factories of mechanical products. The outbreak of the Rebellion found the government in possession of the best equipped small arms factory in existence, but still one which was incapable of producing arms with anything like the speed necessary, and machine shops of all kinds were called upon for assistance through contracts for the production of arms. The contracts closed, the proprietors of these shops proceeded to Springfield to learn how the work was there done and, returning home, adopted similar methods in carrying out their contracts. Meanwhile enlargements, extensions and improvements of methods were the order of the day at Springfield. Mr. Pratt and Amos Whitney had formed a copartnership and opened their shop in Hartford in 1860—the business association thus begun being destined to continue for over forty years. They soon found a field of activity in supplying new machinery for the Springfield Armory and for the numerous government contractors. Record and history making were rapid for "there were giants in those days." Such rapid progress in methods of manufacture and in machine tools was probably never

seen before nor since. New machines for special processes appeared in rapid succession, some of which, in slightly modified form, still endure as standards. Not only were the equipment and methods of the Armory rapidly improved, but Pratt & Whitney rapidly became the acknowledged headquarters for machinery of the class required. Presently the war was over and the demand for guns ceased, but the manufacturers had received an education in new methods for which history furnishes no parallel. In short, a knowledge of the interchangeable system of manufacture had been spread broadcast throughout the manufacturing sections of the country, and this is far from the least important of the many indirect effects of that great struggle. The war over, the period of recuperation began and the age of machinery was fairly ushered in. The sewing machine was ready for adoption as a household implement. It was required in numbers fairly comparable with the war demand for guns, and it offered an obvious field for the use of the new methods. The manufacture of agricultural machinery, too, was about to become a large industry, and, while of much coarser character, it was not less exacting in its requirements, and the same general principles of production applied. Watch manufacture on American soil was about to become a large industry and here, too, the methods applied. The watch factory at Waltham was the direct outgrowth of the Springfield Armory, the men who established it having learned their art there, and it was there that they acquired the inspiration which led them to undertake the manufacture of watches. Few more courageous industrial enterprises have ever been seen than the Waltham watch factory. The watchmaking industry was then believed to be almost occult in its nature. There was supposed to be something in the very soil or climate of Switzerland that made that country especially fitted to the industry. The personal element and hereditary skill were supposed to be essential to it, and to deliberately claim that if watches were made alike they would be alike was heretical, not to say blasphemous.

Meanwhile the fame of the work at Springfield had spread abroad. The impossible was accomplished. One could dismantle a number of guns and reassemble the parts without regard to their former groupings. In the early 70's, shortly after the close of the Franco-Prussian War, an agent of Pratt & Whitney visited Prussia and discovered that the German armories were equipped with inferior tools. The attention of the authorities was called to the work done in American armories and Mr. Pratt was soon called to Germany. He was absent about six weeks, two of which were spent in Berlin, and then returned to Hartford with orders from the German Government for gun machinery aggregating in value $350,000. Following this, though on a less extensive scale, came the refurnishing of the armories of France, Russia, Sweden and Denmark. This came at a most opportune time—during the depression following the panic of 1873—and because of it the works of Pratt & Whitney were kept busy at a time when other industries were at their lowest ebb.

An outcome of this work for the armories of the German Government, which included those at Spandau, Erfurt and Danzig, was a testimonial letter written in 1875 and signed by the official inspector of small arms for the German Government. This was highly prized by Mr. Pratt and is still preserved at Hartford.



FRANCIS A. PRATT.

This business, together with much additional in other lines of manufacture, was secured primarily by Mr. Pratt, who made no less than ten trips to Europe and secured business there for his company aggregating over two millions of dollars. Thus, in fact, was born the European trade in American machine tools which, like the nationalization of the interchangeable system, is to be credited largely to the influence of the Civil War.

In addition to numberless features and methods which have become standard practice in machine construction, Mr. Pratt was intimately associated with two other developments of the first order of importance—standard measurements and gear tooth cutters. Only those whose mechanical memory goes back to the 70's can understand how mechanical progress was impeded by the then existing confusion in the matter of accurate measurements. So-called standard gages were made by Whitworth, but different sets did not agree. Pratt & Whitney took up the work in 1879 with a seemingly lavish prodigality of expenditure, the result of which is the present satisfactory condition of the subject of measurements.

The theory of the shapes of gear teeth had been well understood for many years, but no attempt at anything which could be called precision in their incorporation in actual gear teeth had been made until Pratt & Whitney took up the subject and brought out their epicycloidal milling machine and pantographic engine for the making of gear cutters in 1880, for which Mr. Pratt is entitled to a large amount of credit. The direction of progress has, of course, been away from the epicycloidal tooth, but that does not diminish the importance of this work in precision methods, which was far in advance of preceding practice.

Mr. Pratt was the original designer of what is known as the Lincoln pattern of

milling machine, the design having been made in the 50's when he was superintendent of the Lincoln Foundry and Machine Company. The Pratt & Whitney Company alone have made over seven thousand of these machines. How many have been made by others it is impossible to say. The machines made to-day differ but little from Mr. Pratt's design of over forty years ago. It is doubtful if any other machine tool has been made through so long a period with so few changes.

His mechanical activity continued to a very recent date, late improvements in drop hammers being due to him.

One of his most pronounced characteristics was a constant desire to give full credit for creditable work. He felt that the mechanic had received but a small part of the credit to which he was entitled for the development of the country, and to do what he could to rectify this had promised for our columns some historical reminiscences and had in fact made a beginning in that direction. The interest that would have attached to their publication may be inferred from what is given above regarding the development of interchangeable methods at the Springfield Armory and of the manner in which those methods became characteristic of American shops. The story as given was taken by the writer from Mr. Pratt's own lips.

He set high value upon technical education and upon technically educated men and often expressed his appreciation of the value of such men to his company. In a way this was but an illustration of his constant desire to give credit to others, but considering that he had been raised in a very different school, it was also an excellent illustration of his liberality of mind and of the breadth of his judgment and opinions.

The portrait which we give is a reproduction of a steel engraving and is a speaking likeness.

Personal.

B. H. Warren, vice-president of the Westinghouse Electric & Manufacturing Company, has resigned his office.

W. L. Cheney, who has been doing engineering work in the Newark (N. J.) plant of the Westinghouse Electric & Manufacturing Company, has resigned.

W. W. Root, who was formerly general western freight agent of the Big Four at Kansas City, has taken service with the S. Obermayer Company, manufacturers of foundry facings, etc. He will look after the traffic of the plants of the company at Chicago and Pittsburgh, as well as at Cincinnati.

Our esteemed contributor, Herbert L. Towle, has opened an office at 123 Liberty street, New York, for general machine design. He will pay special attention to gas engine and automobile work in all branches, including tests, alterations and correction of balking engines, and will carry on a general drafting and tracing business.

At the annual meeting of the Engineers' Club, Scranton, Pa., the following officers for the ensuing year were elected: President, H. H. Stock, editor of *Mines and Minerals;* vice-president, B. F. La Rue, professor of civil engineering in the International Correspondence Schools; secretary, A. E. Lister; treasurer, F. J. Platt; corresponding secretary, A. B. Dunning; librarian, H. M. Lane, professor of mechanical engineering in the International Correspondence Schools; directors, W. M. Marple, C. C. Rose, and H. W. Rowley.

Obituary.

William Hopkins, superintendent of the Iowa Iron Works, Dubuque, Iowa, died February 5, sixty-two years old. Mr. Hopkins came to America from Glasgow in 1861 as a boilermaker, working in Boston and Toronto. He started a boiler shop in Dubuque in 1864, later uniting with another firm and together developing into the Iowa Iron Works.

Edward Everett Quimby, inventor and patent expert, died at Orange, N. J., February 17, seventy-one years old. Mr. Quimby when a young man invented a screw machine used by the American Screw Company and later became superintendent of their works. For many years he had been a patent expert and was connected at different times with some of the most important patent cases, such as the Bell telephone, the Harvey steel process and the Mannesman tubes.

Correcting a Drawing.

Editor American Machinist:

In Fig. 3 of my article, entitled "Making a Large Safety Pin," at page 262, the part lettered *Z* extends too low. I should have drawn it ½ inch higher. As it is, the drawing die *H'* evidently would not be able to descend low enough to do its work.

WILLIAM DORAN.

Methods of Analysis for Cast Iron.

The following circular is sent out by the committee of the American Foundrymen's Association:

Pursuant to instructions received at the Buffalo convention of this association, careful inquiry has been made as to the feasibility of recommending given methods for determining the constituents of cast iron as the standards of the association for the foundry trade. The consensus of opinion seems to be that a standardization is a highly desirable one, but that no one method only be selected. All those methods giving concordant results within the limits of commercial accuracy should be allowable. The committee would therefore request laboratories or chemists to send to the undersigned any method for the determination of the total carbon, graphite, silicon, manganese, phosphorus and sulphur in cast iron which it would recommend for adoption as standard. The literature thus received will be reviewed by chemists of national repute, and all methods known to give commercially accurate results, selected for recommendation as standards. Should it be possible to secure such a selection, a great boon will be conferred upon foundry, blast furnace and laboratory management alike, and your kindly attention and aid are therefore urgently requested.

THOS. D. WEST, Chairman.

Sharpsville, Pa.

Commercial Review.

NEW YORK, Monday, February 24.

MR. KATES ON CUBAN AND OTHER AMERICAN MARKETS.

We have before in these columns quoted the opinions of Mr. Norbert B. Kates, of the firm of Kates & Bok, 56 Pine street, New York, who are doing an aggressive work in the export of machinery, especially to Spanish-American countries. Mr. Kates has recently been on a business trip to Cuba and Mexico. He is strongly impressed with the necessity of granting the proposed concessions on Cuban sugar. He states that the representations made on behalf of the needs of the island are not at all exaggerated, and he believes that a compliance with them is vital to our own interest, setting aside entirely the question of moral obligation. It is assumed, of course, that the concessions are reciprocal and that after the Cuban Congress has assembled, which is likely to be in a couple of months' time, reductions are made upon American goods imported into Cuba. Against a reduction of sugar duty that may be taken as amounting to $8,000,000 to $12,000,000 per annum he sets $100,000,000 annually of export trade with Cuba. The present Cuban exports of some $70,000,000 ought to be $100,000,000, and we should be able to get 80 per cent. of the whole.

The island is dependent upon outside countries for her manufactured goods, such as machinery, and under present conditions she finds it profitable to buy largely in Europe. A great deal of her sugar machinery comes from across the Atlantic. Indeed, her imports from America are actually decreasing. They now amount to only about $28,000,000 a year. Tariff concessions of 33⅓ to 40 per cent. on American goods would divert the trade to this country, and with an assurance of prosperity for Cuban industries their demands upon the United States for equipment would be heavy. Plantations and haciendas are in need of a great deal of machinery. A cordial sentiment toward the United States is entertained both by the native Cubans and the Spanish inhabitants. The latter comprise nearly all the business people, and he finds that they desire permanent annexation to this country. Such an outcome he considers practically certain, whether it

takes one, two, three or four years to bring about.

The result of refusing the sugar concessions now solicited, Mr. Kates is confident, will be the utter business ruin of Cuba and its commercial value to us. It will quite probably mean immediate political failure of the Insular Government, since there is doubt whether in such an event President-elect Palma would consent to take his seat.

Mexican conditions are improving, Mr. Kates informs us, there having been some financial stringency there for the last year which has been felt by the various local industries. He confirms the general industrial advancement of the country, which has long been noticed.

Mr. Kates is a firm believer in the South American markets as an outlet for American machine tools. Speaking not for the present and immediate future so much as with a broader view, he holds that the requirements of that region will supply the apparently lasting deficiency of our European demand. In South America and also in South Africa an important opening for machine tools may be expected before one is developed in the Far East.

Kates & Bok are constantly shipping machine tools to Spanish-American countries, and they find encouragement in the facility with which one sale paves the way for another. Among their business in the Argentine they have supplied a shafting manufacturing equipment built by a company in St. Louis, as well as some pulley-making machinery. A large lathe of the New Haven Manufacturing Company for Cardenas, Cuba, is one of the most recent shipments. Mr. Kates is now contemplating another business trip—not improbably to South Africa or the Far East.

VARIOUS MATTERS OF TRADE.

The Pittsburgh Railways Company has let contracts which, it is said, will absorb the greater part of $2,000,000 allowed for the betterment of the service. The equipment ordered includes six engines from the Providence Engineering Company, aggregating 13,500 horse-power, and a battery of Babcock & Wilcox boilers.

The Pittsburgh Machine Tool Company, Pittsburgh, Pa., has recently made shipments of a 50-inch lathe to the Sandy Hill (N. Y.) Iron & Brass Works and twenty-one special lathes to the British Westinghouse Electric & Manufacturing Company's plant, Manchester, England.

The U. Baird Machinery Company, Pittsburgh, has taken the contract for about forty tools for the new plant of the American Turret Lathe Company, Warren, Pa.; also the machine-shop equipment of the United States Engine Company, Parkersburg, W. Va.

The Pratt & Whitney Company has just arranged to establish a branch office in Pittsburgh. D. L. Macomber is to take charge of this office, which will be in the Frick Building.

One of the most important engine building enterprises now on hand is the enlargement of the Hooven, Owens & Rentschler Company's works, Hamilton, Ohio. The project calls for an outlay of some $350,000 or $400,000. New equipment will be put in, including special tools for building vertical engines, which is a line to which the company proposes to devote considerable attention. It is understood that the building and the equipment contracts have, for the most part, been let and that a good proportion of the tools are to be of Niles construction.

The Philadelphia Pneumatic Tool Company is anticipating that its returns of the present month will show an aggregate exceeding that of any month previous. In regard to export trade, some good shipments have been made already this year. Demand has come through the company's Scandinavian agency and from Berlin, Paris and London. The company reports the appointment of Berger, Carter & Co., 330 Market street, San Francisco, Cal., as its representatives on the Pacific Coast.

The Harrisburg Foundry & Machine Company has sold three 150 horse-power Harrisburg Standard engines for the Flat Iron Building, New York city, to be direct connected to Bullock generators, and two 90 horse-power engines of the same type for the Woman's Hotel.

The Waukesha (Wis.) Sheet Steel Company writes that it is fully equipped and in operation. The report emanating from Pittsburgh that its vice-president and general manager was in that city for the purpose of letting large equipment contracts for the plant was therefore incorrect.

The Skinner Chuck Company, New Britain, Conn., has completed arrangements with the Cushman Chuck Company, Hartford, Conn., which enable the former to offer, in addition to the regular line of chucks which they manufacture, the following: Universal geared scroll chucks, universal lever scroll chucks, universal and independent 2-jaw chucks, box bodies; Key, Acme and Peerless drill chucks. Reciprocally the Cushman Chuck Company now sell the Skinner combination lathe chucks, in addition to the chucks which they manufacture.

CHICAGO MACHINERY MARKET.

The question of the size of stocks has gained importance with Western jobbers of machinists' supplies and with the representatives of manufacturers of these supplies and furnishings. The volume of current trade has increased so measureably that old stocks no longer suffice to insure prompt deliveries and orders to factory by wire, shipment to be made by express, are on the increase. This rather expensive manner of looking after business has its origin largely in the opinion that the recent heavy business may at any time wane, in which event an unusually large stock would be undesirable. But the orders do not sensibly, as a rule, depreciate in volume. A single mail may deplete a given size or specialty, even though the quantity on hand be sufficient under ordinary circumstances to last for two months. And speaking of mail orders, it is noted that business of that description is very satisfactory. Numerous orders come from people who are new, and are for large quantities of supplies. There is a constant broadening of trade and it is manifest both in the city business and that marked taste for machinists' supplies and marked taste for machinists's uspplies and shop fittings and the Pacific coast is a most excellent buyer.

The volume of trade is well maintained. One of the sellers of shop furnishings thinks the aggregate is somewhat less than in January, but there are more who say January was a record breaker and that February is little, if any, behind. General business conditions in the West were never surpassed. There are heavy inquiries for building material and the makers of structural shapes are practically out of the market for this year, so that the beginnings of an accumulated trade for 1903 seems to be already visible, unless foreign steel can be obtained as a substitute. Railroads east of Chicago are unable to handle the freight offered, but the Western lines can usually furnish cars when wanted. The famine in pig iron, wrought largely because the coke supply is short, has induced a remarkable activity for deliveries during the last half of the year. There are not in some lines of manufacture the cramped conditions that existed a year ago, for facilities for production have increased generously, but the total volume of sales is undoubtedly larger than then.

The Reeves Pulley Company is doing a better business than a year ago. One order just closed is for a $5,000 transmission of power outfit for a California shingle mill. The Machinists' Supply Company note that business has never been better with them than during the past six weeks. The trade of C. H. Besly & Co. is broadening, running largely to mail orders. The Chicago Belting Company reports a heavy trade. Among recent orders was one for a considerable amount of belting from Mexico.

Quotations.

NEW YORK, Monday, February 24.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$18 15 @ $19 40
No. 2 X	17 65 @ 18 90
No. 2 plain	17 15 @ 18 40
Gray forge	16 65 @ 17 90

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 18 25
No. 2 foundry, or soft	15 75 @ 17 75
No. 3 foundry	15 25 @ 17 25
Foundry forge, or No. 4	14 75 @ 16 75

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.73c. in carload lots. Smaller quantities from store, 1.95 @ 2.00c.

Tool Steel—Base sizes—Good standard

quality, 7c.; extra grades, 10c. and upward.

Machinery Steel — Base sizes — From store, 2.00c. The mills, however, have decided to quote a list of extras for small quantities ranging up to 0.25 a pound on lots below 500 pounds. This covers all open hearth but toe calk and spring steel.

Cold Rolled Steel Shafting—Base sizes —From store, 2½c.

Copper—Lake ingot, 12½ @ 12⅝c.; electrolytic, 12⅜ @ 12½c.; casting, 12¼ @ 12⅜c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 26 @ 26¼c.

Pig Lead—4.10 @ 4.12½c. in 50-ton lots.

Spelter—4.30c., New York delivery.

Antimony—Cookson's, 10 @ 10½c.; Hallett's, 8 @ 8⅛c.; various brands, 7¾ @ 7⅞c.

Lard Oil—Prime City, 79 @ 80c., wholesale.

New Catalogs.

Pawling & Harnischfeger, Milwaukee, Wis., have sent us a new pamphlet upon hand traveling cranes. This is a secondary feature of their business, the primary one being electric traveling cranes. The pamphlet is 10¾x7½ inches.

The New Britain Machine Company, New Britain, Conn., publishes a little pamphlet (3½x6½ inches) relating to machine shop furniture in iron and steel, such as tool racks, lathe pans and shelving. The company has gotten out lines of revolving screw and tool racks and a line of steel stock racks, which are shown on an enclosed leaflet.

The Bethlehem Foundry & Machine Company, South Bethlehem, Pa., has sent us a catalog of metal-working machinery, including the following types: Rotary shears and auxiliaries, angle bender, universal bender, 800-pound double-acting steam hammer, alligator and vertical gap riveters, punches, shears, power presses, etc. The pamphlet is 6x9 inches, standard size.

We have received from Edgar T. Ward & Sons, 23-25 Purchase street, Boston, Mass., two pamphlets. One of them (5x6½ inches) is a list of stock in bar, sheet and strip steel and steel wire, drill rods, cold rolled steel of varied description, hack and power saw blades, brass tubing and rods, etc. The other pamphlet (3⅝x6 inches) is a net price list of circular blanks made from Seebohm & Dieckstahl's specially annealed Dannemora tool steel.

The Billings & Spencer Company, Hartford, Conn., has published a new catalog (7x10¼ inches) devoted to its patent improved drop hammers, etc. The new features embodied in the catalog include a new die shoe, board guard and a table giving weights of hammers and shipping weight, and stating cubic measurement for ocean shipment, etc. The company also lists drop boards, a new heating furnace and Lombard's patent lifting jack.

We have received copies of "Grant's Gear Book" for 1902. This is a catalog of the Grant Gear Works, 6 Portland street, Boston, Mass., and the Philadelphia Gear Works, 127 North Seventh street, Philadelphia, Pa. It contains price lists of many standard forms of brass, iron and steel gearing, sprocket chain, etc., with illustrations hinting at less common types of gearing which the works are prepared to execute upon occasion. Size of page, 5x8 inches.

The Rockwell Engineering Company, manufacturer of fuel oil burning appliances, 26 Cortlandt street, New York, sends us two pamphlets. One of them—Catalog B—is entitled "Fuel Oil for Boilers." Catalog C contains an elaborate series of views of furnaces, most of them for oil or gas, some of them also for coal fuel, and designed for annealing, hardening, heating, brazing, melting and other purposes. Among them are some forges. The pamphlets are 10x8 inches.

The Pond Machine Tool Company, 136 Liberty street, New York (works, Plainfield, N. J.), has published an unusually handsome catalog showing its latest line of heavy lathes. This is a red-line edition with ample margins, and presents a series of machines ranging from a 28-inch up to an 84-inch lathe. A number of forge lathes are among the types illustrated, and there is a 42-inch triple geared facing lathe, also a four-tool shafting attachment. The catalog is of large standard size, 9x12 inches.

The Blanchard Machine Company, 16 Harcourt street, Boston, sends a little pamphlet devoted to the Blanchard air compressor. The principal feature of this compressor is that all the working parts are enclosed and are oiled by the splash method of lubrication, the same as in various new types of high-speed engines. The machines are also provided with valves of a new design, which do not pound on the seats, being air cushioned at the ends of the stroke. The catalog is 6x3½ inches, standard size.

We have received from the E. W. Bliss Company (comprising also the Stiles & Parker Press Company), Brooklyn, N. Y., a special copy of the twelfth edition of its catalog and price list of presses, drop hammers, shears, dies and special machinery. We do not know that there is anything in this volume that has not already been in print for some time, but the present copy is a handsome book, in flexible leather cover, specially stamped with our name. It contains 534 5x7-inch pages, with additional pages for memoranda.

Manufacturers.

The Atlas Engine Works, Indianapolis, Ind., propose to make extensions.

The Sistersville (W. Va.) Bottle & Glass Jar Factory will be built at once.

Lovewell & Co., machinists, Chelsea, Mass., propose to build a foundry, 50x80 feet.

Tonks Bros. & Co., Newark, N. J., button manufacturers, will build a new factory.

The Wilbur Lumber Company, Milwaukee, Wis., has broken ground for a new building.

The Menke Pottery Company, of Trenton, N. J., has selected Millville at a site. It will manufacture jugs.

The Metropolitan Electric Company, Reading, Pa., is about building an annex to its power-house.

George L. Knauss is building a machine shop, 25x60 feet, at Rittersville (post office at Allentown), Pa.

It is reported that the Seaboard Air Line Railway will erect an addition to the shops in Portsmouth, Va.

The Jeanesville Iron Works Company, Jeanesville, Pa., intends building another addition to its shops.

The Standard Tie Company, of Detroit, Mich., is beginning the construction of a sawmill at Au Train.

Buckeye Foundry Company, Cincinnati, O., has secured additional ground on which it will enlarge its plant.

A car repair shop is to be erected at Newtonville, Mass., by the Boston & Suburban Street Railway Company.

One of the largest mills of the Bodcaw Lumber Company at Stamps, Ark., has been burned. It will be rebuilt.

The Vulcan Iron Works, Seattle, Wash., will erect a rolling mill at an early date, to have a capacity of 30 tons daily.

The Buckley Fish Company, of Cleveland, O., will build a fish canning and fertilizer factory at Menominee, Mich.

The plans and specifications have been prepared for the new buildings for the Wilkes Foundry Company, Toledo, O.

The American Bridge Company intends to build a new machine shop, 50x186 feet, at its East Side plant at Pencoyd, Pa.

There is an unconfirmed rumor that the Chicago & Alton railroad will build a 40-acre car shop plant in Will County, Ill.

Blonder Bros., manufacturers of iron beds, etc., have taken out a permit for a factory at 135 West Superior street, Chicago.

The Goodall Worsted Company, Sanford, Me., will build a new brick mill, to be used as an addition to its weaving department.

The plant of the Schoeneck Company, manufacturer of architectural iron work and awnings, Syracuse, N. Y., will be improved.

The Louis Lipp Company, Cincinnati, O., will build a foundry plant at Fifth and Wayne streets, that city, to do general jobbing work.

The Toledo Tube Company, manufacturer of tubing, shovels and stove trimmings, Toledo, O., proposes to erect a larger factory building.

The McKenny-Gazelle Company, of Baltimore, Md., has been negotiating relative to building a sewing machine factory at Topeka, Kan.

E. B. Marsh Bros. & Co., machinists, of Snydersville, Monroe County, Pa., have secured a location for their foundry in East Stroudsburg.

The Wisconsin Lumber & Bark Company, of Grand Rapids, Wis., will erect a sawmill near Eagle River, and later a veneer and furniture factory.

The Perkins Electric Switch Manufacturing Company, Hartford, Conn., is building a factory in Bridgeport, to which city it will eventually move.

An addition will be built to the plant of William Scholes & Sons, manufacturers of yarns, at Second street and Indiana avenue, Philadelphia, Pa.

Fire in the planing department of Gustave Berger's sash and door factory at 2527 Bodine street, Philadelphia, Pa., has caused a loss of about $30,000.

The Calorific Heater & Manufacturing Company, Allentown, Pa., has had plans prepared for a new foundry and machine shop, cleaning and testing room, etc.

The building of the compressed air plant at the Union Pacific shops, Omaha, Neb., is being torn down to make way for the new pattern shop, 200x49 feet.

The New York Safety Car Heating & Lighting Company is about to erect a four-story building, 50x50 feet on Erie and Eleventh streets, Jersey City, N. J.

Arrangements have been made for beginning work on the excavation for the plant of the Knoxville Iron Company, between Knoxville, Tenn., and the Southern shops at Lonsdale, as soon as the weather will permit. The entire plant, when completed, will cost from $400,000 to $500,000.

The Minnesota Clay Company has filed articles of incorporation. Its headquarters are in St. Paul, but the plant, which will cost $100,000, will be at Coon Creek, Anoka County. Contracts have been let for a complete brick factory. The officers of the company are: President, G. H. Shellenberger;

vice-president, F. D. Kendrick; secretary and treasurer, V. Gilman.

It is reported from Denver that the Colorado Fuel & Iron Company will construct a new wire and nail mill at Pueblo, Col., with a daily capacity, at the start, of 750 tons of finished product. When this addition is completed the works of the fuel company at Pueblo will employ over 12,000 men, and possibly one-third of that number in mines, smelters and railways located elsewhere.

E. & T. Fairbanks & Co., St. Johnsbury, Vt., have purchased the Dupont power hammer, the Howard saw and the Howard power hammer with patents and rights and the machinery and equipment employed in the present manufacture by the Dupont Manufacturing Company and L. D. Howard. They will push the manufacture and sale of these hammers and saws in connection with the scale business.

It is reported that the Pacific Steel Company will put up a $2,000,000 or $3,000,000 plant. The Seattle (Wash.) men prominently interested in the company are Homer H. Swasey, president; Maurice McMicken, vice-president, and William Pigott, one of the trustees. It is said that the company controls all the known deposits of iron in the Northwest. It now owns a plant at Irondale, near Port Townsend, Wash.

For a number of years John T. Metcalfe, Quincy, Pa., has manufactured gas and gasoline engines the demand for which has increased so greatly that a company is being formed to build them on a more extensive scale. It is composed of John T. Metcalfe, D. Maurice Wertz and B. R. Summers, Quincy, and D. M. Good, Jr., George B. Beaver, S. M. Kitzmiller and J. J. Oyler, Waynesboro. A charter will be applied for March 11.

J. D. Daniels, a former director in the American Linseed Company, and until recently general manager of its Buffalo works, is about to erect a linseed oil plant at Cleveland, O. The contract has been let for the buildings, plans for which were prepared by Meade & Garfield. Specifications have also been drawn up for the erection of "marine leg" apparatus for unloading grain from vessels. Mr. Daniels expects to form a company.

The William B. Pollock Company, steel and iron plate construction for blast furnaces, steel works, etc., Youngstown, O., since the destruction of its works by fire, has built a new and larger plant on a new site and is ready for business. The company has equipped its buildings with overhead electric traveling cranes, added new tools of the latest makes and largest sizes, each independently operated by a motor. It has eight pneumatic plants for riveting, calking, chipping and drilling on work outside of the shops.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Stamping dies. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

For Sale—Machine works and foundry; fine modern equipment; all good as new; good reasons for selling. Address Burger Bros., Delphos, Ohio.

Wanted—$15,000, to manufacture machines and operate factory for making self-opening, square and satchel bottom paper bags. Address Box 663, Alexandria, Ind.

Purchaser for small manufacturing plant; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

For Sale (account sickness)—1 lathe, 18 in. by 8 ft., Dietz, Shoemaker & Boye, extra heavy, C. P. rest, 1 9-16 in. hollow spindle, 5-step; new 15 in. P. & W. chuck, 18 tools and belting; all A No. 1 condition; price $190. Box 202, AMERICAN MACHINIST.

Wanted—Parties with capital, to join with advertiser in incorporating company for the manufacture of a line of machinery and a specialty which promise excellent returns; principals only; a strictly legitimate enterprise. Address "Ring," care AMER. MACH.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

I have sheet metal specialty business, yielding handsome profit, with established agents throughout United States; want partner with capital to increase manufacturing plant, or would consolidate with similar line. Send full particulars to A. R. Bailey, 75 Clymer st., Brooklyn, N. Y.

I have an established and paying hardware specialty manufacturing business and desire an ambitious and competent partner to take entire care of mechanical end, which is distasteful to me; investment of a few thousand required; good chance for growth. Box 187, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Draftsman, technical graduate, desires change. Box 182, AMERICAN MACHINIST.

A position as superintendent or general foreman. Box 192, AMERICAN MACHINIST.

A1 general foreman machinist of wide experience desires change; references. Box 201, AMERICAN MACHINIST.

In New England, mechanical draftsman and designer, competent to manage drawing room. Box 175, AMERICAN MACHINIST.

Young man, 22 years of age, wants employment as tracer or to make drawings from sketches. Box 194, AMERICAN MACHINIST.

Machinist foreman or superintendent, first-class mechanic and good executive ability, desires change. Box 204, AMER. MACHINIST.

Steel Measuring Tapes and Rules.—Expert desires position with a firm contemplating going into the line. Address Box 203, AM. M.

Machine shop foreman, experienced, thoroughly practical and reliable; first-class references. Address P. O. Box 239, Quincy, Ill.

Mechanical engineer, with extensive experience at designing machinery and tools for manufacturing purposes, wants to change. Box 196, AMERICAN MACHINIST.

Bright, ambitious young draftsman desires position where there are good chances for advancement on merit; A1 references. "Worker," care AMERICAN MACHINIST.

An erecting engineer, 25 years' experience with general machinery, desires position as master mechanic of mill or factory; best references given. Box 172, AMER. MACH.

Wanted—Position as foundry foreman; up to date on engine work, machinery and jobbing, heavy or light; 16 years' experience as foreman; A1 references. Box 191, AM. M.

Mechanical engineer, experienced designer of automatic machinery and tools, thoroughly competent to take charge of design and construction, graduate, with references, wants responsible position. Box 148, AM. MACH.

Situation wanted as superintendent or general foreman on high-speed engine or Corliss engine work; understand the business from A to Z, and cost-accounting and systematizing of work in shop. D. W. J., care AM. MACH.

A designing engineer, well up in Corliss engines, pumping machinery and power transmission, practical, inventive, accurate, wide experience as constructor and erector, familiar with shop practice, is open for engagement. Box 154, AMERICAN MACHINIST.

A thoroughly practical, experienced superintendent, at present employed in the West, desires a change; Eastern or Middle States preferred; small and medium interchangeable work, tools, jigs, etc.; 20 years' experience. Box 200, AMERICAN MACHINIST.

Wanted—Position as superintendent or general foreman, by up-to-date man; either light or heavy work; at present manager of concern manufacturing light interchangeable machinery; particulars on request. Address M. E., care AMERICAN MACHINIST.

Mechanical engineer with a thorough knowledge of modern shop practices, acquired from 16 years' practical experience with general, special and automatic machinery, hydraulics, etc., is open to an engagement about March 15. Address Box 197, AMERICAN MACHINIST.

Engineer solicits business; ideas developed; complete working drawings of structural or mechanical work executed rapidly and accurately; neat tracings made; contracts taken for detailing columns, beams and girders; estimates. Address "Satisfaction," care A. M.

Experienced mechanical engineer, 30, now holding position as superintendent of large manufacturing concern (engines, boilers, general machinery), wishes to change; have also charge of factory office, engineering, accounting, estimating; competent, energetic, up to date. Address Box 193, AMER. MACHINIST.

Wanted—Position as superintendent or manager in large works; have line of machine tools; would exchange for interest; 20 years' experience; now holding position as manager; first-class handler of men and up-to-date methods, piece-work system; reference the best. Address F. C. S., care AMER. MACH.

An expert mechanic, technical and practical, with 15 years' successful experience in shop and office, in management of help, buying machinery and supplies, and in design of tools, methods for quick and accurate work, seeks position as superintendent or manager; experience covers both light and heavy machinery and small interchangeable work; best of references as to character and ability. Address "X L," care AMERICAN MACHINIST.

Help Wanted.

Wanted—Technical graduates for engineering work. Address X. Y. Z., care AM. M.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

A thoroughly experienced and accurate mechanical draftsman wanted. Sprague Electric Co., Bloomfield, N. J.

Wanted—First-class draftsman, accustomed to machine tool work. G. A. Crosby & Co., Limited, Sarnia, Ontario.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Wanted—Two experienced patternmakers for Colorado; wages 30 cents per hour. Address Box 105, AMERICAN MACHINIST.

Wanted—Wood pattern maker, experienced on valve work; state experience and age; location near Albany. Box 189, AM. MACH.

Three machine tool foremen, two erection foremen and two inspectors used to heavy machine work. Box 115, AMER. MACHINIST.

Wanted—Young man with some knowledge as draftsman, to work on drawings and about machinery in general. Box 178, AMER. MACH.

Wanted—First-class wood pattern maker. Address, stating experience, age and wages wanted. Wm. E. Hill & Co., Kalamazoo, Mich.

Wanted—Experienced draftsman, preferably familiar with hydraulic pump work; state age, experience and reference. Box 167, AMERICAN MACHINIST.

Wanted—Several first-class men to sell Fairbanks gas and gasoline engines; none but well-posted men need apply. Address P. O. Box 688, New York City.

Wanted—A first-class machinist, capable of repairing lathes, planers, boring mills and a general line of machinery. Address Box 190, AMERICAN MACHINIST.

Wanted—Number of patternmakers, experienced on compressor or steam engine work; none others need apply. Franklin Air-Compressor Co., Franklin, Pa.

Wanted—Five experienced machinists for Colorado, to run tools, boring mill, planer

and lathes; wages 30 cents per hour. Address Box 106, AMERICAN MACHINIST.

Wanted—Machinists accustomed to accurate work; good wages and steady employment to the right men. Leland & Faulconer Manufacturing Company, Detroit, Mich.

Two tool draftsmen to design tools, jigs and fixtures in large Chicago manufacturing company; state age, experience and salary expected. Box 199, AMERICAN MACHINIST.

Wanted—First-class toolmakers, experienced on valve tools and fittings, capable of taking charge; state age, experience and wages expected. Box 142, AMERICAN MACHINIST.

Wanted—Several tool and die makers on small work; factory in Worcester County, Mass.; state age, experience and wages expected. Box 168, AMERICAN MACHINIST.

An experienced polisher, competent to take charge of a polishing shop working on fine steel dental instruments and forceps; state age, references, etc. Box 195, AMER. MACH.

Wanted—A few first-class planer and lathe hands on heavy work; good wages to competent men; none others need apply; location Buffalo, N. Y. Address Box 198, AM. M.

Wanted—A competent blacksmith who can act as foreman for a small shop handling a variety of small and medium heavy machine work. Address "Massachusetts," care AM. M.

Mechanics, engineers, electricians, firemen, etc. A free scholarship in engineering will be awarded to a few well-recommended applicants. American School of Correspondence, Boston, Mass.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—A few good machinists to assist in building and adjusting automobiles and gas engines; good positions await men who will each make use of two or three inexperienced men. Address Thomas B. Jeffery & Co., Automobile Works, Kenosha, Wis.

Wanted—Thoroughly competent foreman for brass foundry, experienced in making brass valves and fittings, familiar with molding machinery and mixing of metals; state age, experience, salary expected and references. Box 104, AMERICAN MACHINIST.

Wanted—Experienced and practical young man to travel locally and sell engines, boilers, machinists' supplies, foundry and machine work; state age, experience, references and wages expected. Address "Maryland," care AMERICAN MACHINIST.

Salesman Wanted—To travel in Atlantic Coast States; must be a thorough mechanic of good address; one well acquainted with the Gisholt turret lathe preferred. Apply only by hand-written letter, giving experience and references, to Walter H. Foster, 126 Liberty street, New York.

Wanted—A superintendent for a factory north of New York, engaged in the manufacture of an interchangeable machine; must be young, a good disciplinarian and familiar with up-to-date shop system; salary about $1,800 per year. Address, stating experience and references, Superintendent, P. O. Box 1513, New York.

Wanted—Assistant in sales department of company building Corliss engines; must be a good correspondent and familiar with the preparation of estimates for steam plants of large size; should have practical experience in handling engines; technical graduate preferred; state age, experience and salary expected. Address "Engine," care AM. MACH.

Machinist wanted for working partner in small shop having some good specialties; 15 minutes from New York; must be capable of getting out work to good advantage, of designing tools and methods, with undoubted references as to ability and honesty; small sum to invest desirable, but not a necessity; ability the main requisite. Address B. W. S., care AMERICAN MACHINIST.

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Arbor Press
Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

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Babbitt Metal
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Balls, Steel
Automobile & Cycle Ports Co., Cleveland, O.
Cleveland Ball & Screw Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Bars, Boring
Underwood & Co., H. B., Philadelphia, Pa.

Bearing Metal
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Belt Dressing
Jos. Dixon Crucible Co., Jersey City, N. J.

Belting, Leather
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.

Blue Printing Machines
Pittsburgh Blue Print Co., Pittsburgh, Pa.

Blue Print Wringers
Pittsburgh Blue Print Co., Pittsburgh, Pa.

Blocks and Tackles
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Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.

Boilers
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
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Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
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Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Books, Mechanical
Audel & Co., Theo., N. Y. City.
Baird & Co., Henry Carey, Philadelphia, Pa.
Henley & Co., N. W., New York.

Boring and Turning Mills
Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
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Warner & Swasey Co., Cleveland, Ohio.

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Castings, Brass
Nolte Brass Co., Springfield, O.
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Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

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Ferodowill & Co., J. H., St. Paul, Minn.

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Uniform Steel Co., Newark, N. J.

Centers, Planer
Fay & Scott, Dexter, Me.
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Automobile & Cycle Parts Co., Cleveland, O.
Boston Gear Works, Boston, Mass.
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Whitney Mfg. Co., Hartford, Ct.

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Chucks, Drill
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Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

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Cushman Chuck Co., Hartford, Ct.
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Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
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Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Codes
Lieber Code Co., New York.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

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Countershafts
Builders' Iron Fdry., Provi., R. I.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Couplings, Shaft
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
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Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, Ohio.
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Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
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Crank Pin Turning Machines
Crank Pin Mach. Co., New York.
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Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
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Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

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Dixon Crucible Co., Jos., Jersey City, N. J.

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Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
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Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
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Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

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Bliss Co., E. W., Brooklyn, N. Y.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.

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Barnes Co., W. F. & John, Rockford, Ill.
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Baush Mch. Tool Co., Springfield, Mass.
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Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

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Am. Tool Wks. Co., Cincinnati, O.
Aurora Tool Works, Aurora, Ind.
Baird Mchry. Co., U., Pittsburgh, Pa.
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Gould & Eberhardt, Newark, N. J.
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Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
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Sibley & Ware, South Bend, Ind.
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Amer. Tool Wks. Co., Cincin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drilling & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
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Triumph Elec. Co., Cincinnati, O.
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Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
General Elec. Co., New York.
General Incan. Arc Light Co., New York.
Triumph Electric Co., Cincin., O.
Western Elec. Co., Chicago, Ill.
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Albro-Clem Elevator Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Whiting Fdry. Equipment Co., Harvey, Ill.

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Merritt & Co., Philadelphia, Pa.

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Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gas Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.

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Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
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Sprague Elec. Co., New York.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Troy File Works, Troy, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

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Crane Co., Chicago, Ill.
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Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.

Gears Molded
Farrell Fdry. & Mch. Co., Ansonia, Conn.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
New Process Raw Hide Co., Syracuse, N. Y.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinder, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Modern Tool Co., Erie, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Gorton Mach. Co., Geo., Racine, Wis.
Ransom Mfg. Co., Oshkosh, Wis.
Universal Mach. Co., Provl., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Anderson Tool Co., Anderson, Ind.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Universal Mach. Co., Providence, R. I.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Anderson Tool Co., Anderson, Ind.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Mass.
Universal Mach. Co., Provl., R. I.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provl., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provl., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Alteneder & Son, Theo., Phila., Pa.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Po.
Watson-Stillman Co., New York.

Joints, Universal
Baush Machine Tool Co., Springfield, Mass.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathe Feed
Nat'l Mach. Tool Co., Cincin., O.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Fairbanks Mach. Tool Co., Springfield, O.
Fay & Scott, Dexter, Me.
Lather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Universal Mach. Co., Providence, R. I.
Watson Mach. Co., Paterson, N. J.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Machinists' Small Tools
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
Amer. Tool Wks. Co., Cincin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mch. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springeld, O.

Motors, Electric
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springeld, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec & Mfg. Co., Pittsburgh, Pa.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Copp & Co., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Frothingham, N. L., New York.
Patent Title & Guarantee Co., New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.

Patterns, Wood
Gobeille Pattern Co., Cleveland, O.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe and Fittings
Crane Co., Chicago, Ill.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.

Planers — *Continued*
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hand
Elmes Eng. Co., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Eng. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.

Profilers
Garvin Mach. Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pumps, Hydraulic
Elmes Eng. Co., Chas F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Racks, Cut
Van Dorn & Dutton Co., Cleve., O.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Wks., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Recorders, Speed
Starrett Co., L. S., Athol, Mass.

Rheostats
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
Ball Bearing Co., Boston, Mass.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equip. Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Massberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspon. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Bowler & Co., Geo. H., Cleveland, Ohio.
Davis Iron Works, F. M., Denver, Colo.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C. Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnait, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., N. Y. City.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cincinnati Screw & Tap Co., Cincinnati, O.
Crane Co., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Hart Mfg. Co., The, Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicoga, Ill.
Potter & Johnston Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Valves
See Steam Fittings.

Vises, Metal Workers'
Hollands Mfg. Co., Erie, Pa.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Gearing
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.